THE GEOMETRIES OF NATURE:
A DESIGN LANGUAGE TO FACILITATE
THE POSITIVE PERCEPTION OF NATURAL AREAS

A CREATIVE PROJECT

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ABSTRACT

Society has become more dependent on technology and less in touch with the natural world. Many of our nation's youth no longer understand nature and view natural areas as messy. There is a lack of appreciation for and understanding of nature. Changing children's interaction with nature and its processes offers a significant opportunity to address this problem.

This study explored the features required by a nature education center to be interactive and engaging for children. It looked at the aspects of natural areas that contribute to the negative perception of such places. Finally, it explored how six basic geometric patterns (sphere, polygon, meander, spiral, branch and explosion) and Fibonacci numbers can be applied in the design to facilitate the engagement, understanding, and positive perception of nature.

This was accomplished by evaluating case studies and reviewing literature regarding: landscape preferences and perceptions, aesthetic theories pertaining to natural area design and the geometric patterns found in nature.

This research resulted in the design of a nature education center intended to teach visitors about nature's six basic geometric patterns and Fibonacci numbers by employing them as design elements throughout the center. These patterns were used to create a design that translated nature into something that no longer appeared messy and unkempt to visitors.

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CHAPTER 1 – INTRODUCTION

Project Significance

"The forms we conceive are really patterns, and patterns are the configuration of relationships between natural systems." – David Miller

"When we see land as a community to which we belong, we may begin to use it with love and respects." – Aldo Leopold

"In the end, we conserve only what we love, we love only what we understand and we will understand only what we are taught." – Bata Dioum

As society has become more and more dependent on technology, people have become less and less in touch with the natural world. This lack of connection to the natural world has tremendous impacts on the mental and physical health of the nation. Children are profoundly affected by this disconnect from the natural world. Many feel that this disconnect has led to higher levels of anxiety and stress in today's youth. One remedy is quite simple: children need to spend more time outside and less time plugged into electronics. Outdoor classrooms/nature education centers can be used to help children re-connect with nature. Such areas are often built to provide wildlife habitat and offer children the opportunity to witness first-hand flora and fauna.

However, natural areas can also be viewed as messy and unkempt. Many visitors to wildlife habitat areas find them visually unappealing because of the appearance of disorder. Instead, preferring the more orderly and maintained setting seen in most parks. However, what is preferred by humans, often times does not provide good habitat for wildlife. The ideal scenario to promote reconnection with nature would be a site that is preferred by humans and wildlife.

People tend to prefer what is familiar to them. They also show preference for proportion and pattern. The geometries of nature (sphere, polygon, spirals, meanders, branches and explosions) and Fibonacci numbers are patterns that are familiar to people if only at a sub-conscious level.

This project employed the geometries of nature in a design of a place that would be visually preferred by people while at the same time would provide habitat that is usable to wildlife. The geometric patterns were used to bring a sense of order to areas often viewed as unkempt. The patterns served to translate natural areas into a preferred landscape. The nature education center in this study has been designed to teach visitors about nature’s six basic geometries and Fibonacci numbers by illustrating these concepts through their use in various design elements. By amplifying nature’s patterns and creating a place people like to visit, it is believed that the center can reconnect children to nature and foster an appreciation for nature.

Definition of the Problem

What creates a successful nature education center? What causes people to view natural areas negatively? How can geometric patterns aid in the understanding of nature? How can this information be applied to a nature education center design?

Sub-Problem

What program elements lend themselves to the creation of an interactive, immersive and engaging nature education experience for children?

What aspects of natural areas contribute to people's negative perceptions of such places? How can six basic geometric patterns (sphere, polygon, spiral, meander, branch and helix) and Fibonacci numbers be used as a language that increases visitor understanding of nature and helps create positive perceptions of natural areas?

How can this information be applied to a nature education center design that is visually appealing and educates visitors of nature and its geometric patterns?

Assumptions

- Late elementary and middle school children are interested in learning about the geometries of nature.
- Other members of the community will also be using the facility.
- Richard Louv's theory of Nature Deficit Disorder are correct and that children are negatively impacted by lack of connection with nature.
- "Weedy" natural areas are viewed negatively.

- There is funding for the creation and maintenance of the nature center.
- State and Federal Agencies will ok construction of the nature center.

Delimitations

- This study did not locate funding for the creation and/or maintenance for the nature center.
- This study did not result in construction documents or maintenance plans. Only general planting recommendations will be made.
- This study did not create planting plans or locate plants to be used in the design.
- This study did not develop environmental education curricula. It relied rely on lessons developed by Discovering the Science of the Environment.
- This study did not make estimates of costs to implement the design.
- This study did not obtain any necessary resource agency (IDEM, IDNR, Army Corps of Engineers) permits.
- This study did not conduct post-construction monitoring of the success of the design in creating a healthy wildlife area. It is a demonstration of design enhancement.
- This study did not set rules for the park or establish staffing requirements and duties.

Methodology

This project studied nature's geometric patterns and how these could be used to increase understanding and acceptance of natural areas. It resulted in the design of a nature education center that emphasized these patterns.

The study further investigated the design of nature education centers. The School Learnscape Trust (www.learnscapes.org) has a gallery of projects that aided in the understanding of the elements that make up such projects. Visits to Cool Creek Park Nature Center, Eagle Creek Nature Center, Marian College EcoLab and IslandWood occurred and assisted in the project's design. Site amenities were programmed to match with Indiana University – Purdue University, Indianapolis' Discovering the Science of the Environment program curriculum needs.

The study continued to review literature regarding landscape preferences in order to gain insight into the features favored by people when viewing a landscape. Jay Appleton's *The Experience of Landscape* and Rachel and Stephen Kaplan's *The Experience of Nature: A Psychological Perspective* present highly regarded theories regarding people's landscape preferences. The sources were thoroughly reviewed.

Several environmental psychology studies have also been conducted that shed light on landscape preferences. This study focused on the findings published in the articles "Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK)" by H. Özgüner and A.D. Kendle and "Preference and naturalness: An ecological approach" by A Terrence Purcell and Richard J. Lamb. The results of these studies were examined and summarized.

Literature was reviewed regarding aesthetic theories guiding the design of natural areas. Stephen Sheppard's *Forests and Landscapes: Linking Ecology, Sustainablility, and Aesthetics* discusses these theories and it proved to be a very valuable resource. In particular, the study focused on the visible stewardship aesthetic theory. Joan Nassauer's writing regarding this aesthetic theory were reviewed and provided the basis for the use of nature's geometric patterns to design a natural area that is visually preferred by visitors.

The study also required the review of literature pertaining to nature's geometric patterns and their importance in design. Simon Bell's *Landscape: Pattern, Perception and Process* discusses the importance of such patterns in design and was useful in understanding this importance. Peter Stevens' *Patterns in Nature*, Anirban Dasgupta and Sharmistha Majumdara "Patterns in Nature", WGBH's program Nova: The Shape of Things and John Adam's *Mathematics in Nature: Modeling Patterns in the Natural World* were used to further understand nature's geometric patterns and the forms in which they present themselves. This information aided in the final design of the nature education center.

The design trademarks and philosophy of landscape architect and conservationist, Jens Jensen were also investigated. Jensen's style and ideology aligned with the author's and provided inspiration for design elements included in this project.

Review of the Literature

In order to facilitate the design of such a place, literature was reviewed that explored the benefits of connecting children with nature, the advantages and challenges associated with outdoor classrooms, landscape preference theories, aesthetic theories pertaining to natural landscape design and the geometric patterns present in nature.

In Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder, Richard Louv wrote of the importance of exposure to nature for our youth. He discussed the fact that over the last few generations the amount of time spent outdoors has dwindled. Louv held that this is adversely affecting children's mental and physical health. He hypothesized that lack of exposure to nature could be responsible for the increase in attention deficit disorder. Louv stated that exposure to nature is a crucial part of the growing-up process, resulting in a child who is better adjusted and calmer, but it also creates who has an appreciation for the environment. He professed that it is a necessity for children to spend more time outdoors. Incorporating outdoor classrooms into a child's academic curriculum is an excellent way to reconnect children with nature. The child is able to spend time in nature and receives lessons tailored to teach him or her about the environment (Louv 103-108). Children who understand the natural world around them are less fearful of nature. They gain an affinity for nature and feel compelled to protect it.

In *A National Review of Environmental Education and its Contribution to Sustainability in Australia: School Education the Australian Government's Department of the Environment and Heritage*, the importance of learnscapes to teachers, students and the school itself was highlighted. The publication defined learnscapes as "places where a learning program has been designed to permit users to interact with an environment. They may be natural or built, interior or exterior and may be located in schools, near schools or beyond schools. They may relate to any one or many key learning areas and must be safe and accessible (Tillbury and Garlick 24)." They known in the U.S. as outdoor classrooms. Learnscapes are designed to facilitate a richer learning experience, encourage active participation and involve students and teachers in the care of the site. The benefits of such sites include: helping students appreciate their environment, increasing the biodiversity of the school's campus, promoting the native flora of the area, improving teacher/student relationships, improving parent/teacher relationships, improving the school's image, reducing bullying and vandalism and promoting more effective teaching of environmental education (Tillbury et al 23). This publication established the benefits of outdoor classrooms to environmental education and student reconnection to nature.

Although learnscapes (outdoor classrooms) are beneficial to students, teachers and schools, many science teachers still do not incorporate them into their lessons. Keith Skamp and Iris Bergmann examined this in "Teacher's Perceptions of the Value and Impact of Learnscapes: Implications for Practice." The pair interviewed several teachers in an Australian school system to determine their perceptions of the value of learnscapes and their influence on teaching. Their interviews shed light on why the sites are not being used. The following are reasons for why they are not being used: managing students in an outdoor setting is more difficult, uncertainty of how to use the learnscape, planning outdoor curriculum is more difficult, lack of time to accommodate the outdoor experience, lack of desire to shift the classroom to an outdoor setting and insecurity about teaching in the outdoors (Skamp and Bergmann 11). Many of the reasons cited by the teachers can be reconciled through changes in attitudes toward the use of such classrooms. The benefits of learnscapes were reported to be great enough to warrant an effort to change teacher mindsets and continue to encourage their use.

Often people's use of natural space is closely linked to how comfortable he or she feels in nature. This comfort level is tied to preferences or dislikes people have for elements of a landscape. The field of environmental psychology has conducted much research about these preferences. The most common landscape preference theories have resulted from the work Rachel and Stephen Kaplan and Jay Appleton. Understanding these theories can aid in designing a space that will be comfortable and visually preferred by visitors.

Appleton's Prospect-Refuge Theory stated that landscape preferences resulted when the biological needs of the visitor were met. People prefer places that provide them the ability to see for long distances and ascertain much information about the landscape without being seen by others. In other words, one can see without being seen. Early humans would prefer such landscapes because they would provide the best environment for hunting potential prey. Appleton hypothesized that this preference has been carried forward into the modern day and explains preferences for savanna-like environments (Appleton 68-70). Appleton's theory explained why there is a preference for parks with large expanses of grass dotted with clumps of trees. Keeping this theory in mind will aid in designing a nature education centers/outdoor classrooms that people want to visit.

The Kaplans stated that people tend to prefer what they are familiar with and are cautious of the unknown. They believed that people also have inborn preferences for certain landscape features. One such feature is the winding path because it creates a sense of mystery in the landscape. It implies that there is more to be discovered about the space. Another innate preference is for open spaces. The presence of open space makes a landscape more legible to the visitor. In other words, one can feel as though the landscape can be explored without fear of getting lost. The Kaplans hypothesized that complexity of a place is also important. If a place has complexity, it contains enough features to be interesting to a visitor, but not enough to overwhelm him or her. The final element contributing to preference of a place is coherence. Coherence results when landscape elements are easily organized by the viewer. Patterns of landscape elements make comprehension of the place easier to visitors (Kaplan and Kaplan 54-56). As with the Appleton theory, the Kaplans theories can be applied to a design to create a visually preferred place. Although all preferences are important, the idea that high coherence (recognizable patterns) impacts visitor preference is especially important. It supports the idea that nature's geometric patterns can be used to create a visually appealing natural space.

For the most part, people do like nature and the elements of nature. However, they often do not prefer or feel safe in natural spaces that appear messy and unkempt. Often times, however, natural areas preferred by wildlife are not formal and tidy. It raises the interesting question of how people can say they prefer natural areas, yet at the same time, not really prefer them. The disconnect lies in that what an average person considers natural is often very different than that of a landscape architect, ecologist or wildlife biologist. H. Özgüner and A.D. Kendle studied the attitudes of the public towards naturalistic and designed landscapes. The pair showed several residents of Sheffield, UK pictures of Sheffield Botanical Garden (a formal landscape) and Endcliffe Park (a naturalistic landscape) and surveyed their preference regarding landscape styles. Many felt that the botanical garden was more attractive and felt safer visiting it. They also felt that, although more managed, the formal space was also 'natural'. The residents felt the naturalistic site was beneficial to landscapes, but also appeared a bit untended or derelict. The study revealed that public perceptions of nature and natural were quite different (Özgüner and Kendle 153). The information resulting from the study was very important in gaining insight into the preferences of visitors to a site. The study participants were also asked to list the elements of each landscape that they preferred (water, trees, wildlife, etc). This information led to an understanding of what elements should be included in the design of the site.

Design of natural areas has often been guided by three aesthetic theories: the scenic aesthetic, the ecological aesthetic and visible stewardship aesthetic. Each has arisen out of the needs of humans, wildlife or both. In *Forests and Landscapes: Linking Ecology, Sustainablility, and Aesthetics*, Stephen Sheppard explained the theoretical basis of each category and discussed some of the advantages and drawbacks to each aesthetic (Sheppard 151).

The scenic aesthetic has been driven by the desire for variety in the landscape because of its perceived indicator of scenic quality. The scenic aesthetic emphasizes a natural-looking landscape and matches with public perception of how nature should look (Sheppard 153). As indicated by Kendle and Özgüner, public perception of nature tends to be less than accurate. This incorrect idea of what nature should look like results in environments unsuitable for wildlife. This aesthetic naively assumes that what looks good is also good for wildlife. However, this is often not the case. As Paul Gobster pointed out, dead and downed wood fosters biodiversity, but such wood is often cleared from a site managed with the scenic aesthetic in mind (Sheppard 154). The scenic aesthetic is what can typically be found in city parks. Although, the scenic aesthetic was not suitable for the type of design envisioned for the creative project, it was important to have an understanding of why it has been used.

The ecological aesthetic attempts to focus the management and design of landscapes toward the ecological health of the site. It is rooted in the idea that what is ecologically beneficial will also look good to people when they are educated about ecological function. The theory is that when armed with such knowledge, people will no longer see naturalistic landscapes as messy (Sheppard 157). Although a wonderful ideal, the theory is far from being a reality. It requires the general public to be highly educated about ecosystems and disregards some of the instinctive landscape preferences discussed earlier in this literature review.

The theory that was most applicable to the creative project was Sheppard's visible stewardship theory. This theory is essentially a hybrid of the scenic and ecological aesthetics. The primary focus is not whether the landscape appears natural or formal, but that it appears to be maintained and cared for by humans. Landscapes that show evidence of people's attachment to and respect for nature are theorized to be more aesthetically pleasing. The visible stewardship theory creates a landscape that provides the ecological health described in the ecological aesthetic theory. At the same time, the landscape created is one that is visually preferred by humans (Sheppard 160). This is exactly the type of landscape the project esteemed to create. Understanding this theory further solidified the direction the design of the project took.

"Messy Ecosystems, Orderly Frames" by Joan Iverson Nassauer further established how the visible stewardship aesthetic could be applied to this project. Nassauer agreed that often landscapes of high ecological function are seen as messy. Her research revealed that because most people can not understand ecological patterns, a language must be developed that interprets these patterns into something understood by the general public. In this respect, the ecological aesthetic fails because it designs to enhance ecological function. It should instead "frame ecological function within a recognizable system of forms." She stated that these forms must be easily recognizable. It is due to this idea that Nassuer is in agreement with the visible stewardship theory. Natural landscapes must include "design cues of human intention" in order to be seen as beautiful. She summarized several of the design cues. The most pertinent to this project was the use of bold patterns. The use of patterns to facilitate acceptance of an ecologically balanced landscape became the foundation of this project. Another key point is that vernacular forms should be employed to foster this acceptance (Nassauer 197-204).

There are perhaps no patterns more recognizable by people than those found in nature. Even if at only the subconscious level, people are aware of the geometries of nature. In <u>Landscape: Pattern, Perception and Process</u>, Simon Bell investigated the geometric patterns commonly found in nature. He hypothesized that understanding patterns is important so one can make order of chaos. In this case, patterns were used to make order of "messy" landscapes. Bell correctly believed that natural patterns are all around us and that we often show preference for such patterns (Bell 3). Peter Stevens, author of <u>Patterns in Nature,</u> wrote of the basic geometric patterns found in nature: spirals, spheres, polygons, meanders, branches and explosions (Stevens 3-4). Understanding these common natural geometric patterns was highly applicable to the design of the project.

The literature established that children's disconnect from nature is a problem that needs to be addressed. Connecting children with nature can result in a whole range of benefits. Although nature centers/outdoor classrooms have not typically been used to their full potential, it is important to provide access to such sites. It is important to remember that natural areas are often perceived as messy and can turn visitors away. An understanding of the landscape preference and aesthetic theories was important for designing a nature education center that is preferred by humans and wildlife. The literature reviewed proved highly useful in establishing the importance of designing natural areas with recognizable patterns. The six basic geometric patterns of nature continually present themselves to people. Due to this fact, nature's geometric patterns were the most logical choice to be used to create a design language that facilitates the acceptance and preference for natural areas.

CHAPTER 2 – EXPLORATION OF PERTINENT TOPICS

This chapter discusses several key topics that contributed to the design of the nature education center. By better understanding these topics, one will have an increased understanding of the creative project.

Nature Deficit Disorder

In his book, Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder, Richard Louv discussed how children's lack of outdoor time has negatively affected their physical, social and emotional well-being. He coined the term Nature-Deficit Disorder to describe "the human costs of alienation from nature, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illness (Louv 34)". Louv also discussed studies supporting the benefits of spending time in nature for all ages, but especially children with Attention Deficit Hyperactive Disorder (ADHD). Children in natural settings have been observed to be calmer, more able to concentrate and have greater attention spans (Louv 103, 104). Louv hypothesized that if nature helps to alleviate ADHD symptoms, then perhaps the ADHD is triggered by a lack of time spent outdoors. He stated that medication is only addressing the symptoms and not the cause of the disorder (a child's lack of engagement with nature) (Louv 108).

He also cited lack of contact with nature for a rise in what he calls cultural autism, which is characterized by a dulling, or narrowing of the senses and increased feelings of isolation (Louv 63).

The increased use of technology has led many to experience the world second-hand through internet searches, DVDs and YouTube. They no longer touch, taste or smell many of their experiences (Louv 64). Or if they do experience nature, it is with access to a limited palette. According to North Carolina State professor, Robin Moore, this creates some very real problems in child development. He stated:

> Children live through their senses. Sensory experiences link the child's exterior world with their interior, hidden, affective world. Since the natural environment is the principal source of sensory stimulation, freedom to explore and play with the outdoor environment through the senses in their own space and time is essential for healthy development of interior life…This type of self-activated, autonomous interaction is what we call free play. Individual children test themselves by interacting with their environment, activating their potential and reconstructing human culture. The content of the environment is a critical factor in this process. A rich, open environment will continuously present alternative choices for creative engagement. A rigid, bland environment will limit healthy growth and development of the individual or the group (Louv 65).

Moore asserted that outdoor play allows children to have an experience that employs all of their senses and acts as a creative catalyst that stimulates learning (Louv 85-86). Further support of this ideal lies in architect Simon Nicholson's "loose-parts" theory.

Nicholson's theory stated that that creativity, inventiveness and discovery are related to the type and quantity of different elements available in the environment. He employed the term "loose-part" toy to describe an open ended toy that can be used in a variety of ways and through creative and imaginative play are often combined with other such toys. Typical natural area loose toys are water bodies, trees, shrubs, tall grasses, wildflowers, wildlife present in the natural area, sand and structures to climb on and in. (Louv 86). Studies of children's play habits revealed that when playing in natural areas consisting of grass and shrubs children were more likely to engage in fantasy play and rely less on physicality and more on language, creativity and inventiveness (Louv 87).

Landscape Preference Theories

Prospect-Refuge Theory

British geographer, Jay Appleton explored the question, "What do we like about landscape and why do we like it (Appleton vii)?" in his book, The Experience of Landscape. His research into animal behavior led to a theory that attempts to explain aesthetic preferences toward landscape types, known as the Prospect-Refuge Theory (Appleton vii). The theory was relevant to this creative project because it aided in the understanding of landscape preferences. Once one understands which elements are preferred and why, they can then be applied to site design.

The Prospect-Refuge Theory was closely tied to, and built upon, the Habitat Theory. Habitat Theory asserted that aesthetic preference for landscape elements results from the perception that these elements will provide a favorable environment for survival. This was based on the perception of a favorable environment and not the actuality of one. The theory further asserted that the human relationship with the perceived environment is analogous to the relationship of an animal to its habitat. Furthermore, the theory stated that places that are considered aesthetically pleasing result from a subconscious reaction to the place's ability to provide biological necessities (habitat). It stated simply because a human no longer needs to instantaneously determine habitat suitability does not mean that the instinct ceases to function; it just channels to the aesthetic preference for a place (Appleton 68-70).

Prospect-Refuge Theory is derived from the behaviors of animals when hunting and escaping. Animals on the hunt look for a place that allows them to observe prey without being noticed. The animal trying to elude capture is searching for a place that makes them inaccessible to the hunter. Animals are constantly in a quest to place themselves so that a hunter cannot see them or if they are spotted, they can quickly reach a safe place. Whether hunter or prey, the animal wants to be able to see its adversary without first being seen (Appleton 70). The ability to see and hide is also important to humans. The theory defined the ability to see unimpeded as prospect. Likewise, the ability to hide was defined as refuge. To see without being seen is a more refined and specific version of the desire to simply satisfy biological needs. The Prospect-Refuge Theory then extrapolated that the ability to see without being seen is a necessary step on the way to satisfying those needs. Therefore, a landscape that affords a visitor this opportunity will be viewed as more aesthetically satisfying (Appleton 73).

<u>Kaplan and Kaplan's Theory</u>

Rachel and Stephen Kaplan are professors of psychology at the University of Michigan and prominent in the field of environmental psychology. The pair are known for their research pertaining to how exposure to nature affects people and their relationships. Their book, The Experience of Nature presented their theory on preferences toward natural areas and the landscape elements that trigger such preferences. The Kaplans' research revealed that consistent, distinct environmental preferences exist in people despite diverse settings and demographics. They stated that this information provides insight into innate human requirements for proper functioning (Kaplan and Kaplan 40). Their theory has many basic similarities to the Prospect-Refuge Theory. They stated, "If the information an organism acquires through the power of perception is to aid in its survival, it is essential that it not only perceive what is safe but also prefer it (Kaplan and Kaplan 41). The Appleton and Kaplan's theories assume that preferences animals have towards suitable habitats are also present in humans.

Kaplan and Kaplan began by making some general statements about human preferences. They stated that people prefer natural environments with minimal human impact. People also tend to prefer landscapes that are easy to read to determine necessary information about dangers on the site. They tend to not like a space that is too open or too cluttered (Kaplan and Kaplan 49).

The couple created a table to help illustrate their theory. The Preference Matrix helped explain why people have preferences for the appearance of one landscape over another. It presented the basic informational needs of people: understanding and exploration. Understanding refered to the need for a visitor to make sense of what is occurring in a landscape. Understanding alone is not enough to satisfy people's informational needs; people like to participate in situations that impel them to learn more about their surroundings. Curiosity is innate and exploration is a way to fulfill the need to discover more about a landscape. From these two categories, four patterns emerged that are explained by using the following terms: coherence, complexity, legibility and mystery. These terms described characteristics of the way a landscape is organized. Their presence was felt to contribute to a visitor's preference for landscapes (Kaplan and Kaplan 50-52).

Table 2.1 The Preference Matrix

	Understanding	**Exploration**
Immediate	Coherence	Complexity
Inferred, predicted	Legibility	Mystery

Source: Kaplan, Rachel, and Stephen Kaplan. The Experience of Nature: A Psychological Perspective. New York: Cambridge University Press, 1989. 53

Coherence in a landscape was hypothesized to provide a sense of order to the space and makes it easier for a visitor to quickly learn the layout of the space. Anything that organizes elements of landscape into categories helps to increase coherence. Repeated patterns, textures, colors, etc. help to define a landscape into distinct areas and aid in organizing the space. Coherent spaces are easier to comprehend (Kaplan and Kaplan 54).

Complexity was defined by the Kaplans "in terms of the number of different visual elements in a scene; how intricate the scene is; its richness (Kaplan and Kaplan 53). The higher the complexity, the more exploration of the site is encouraged (Kaplan and Kaplan 54)

Landscapes with mystery offer the promise that a visitor can learn more if he or she just ventures deeper into the site. Mystery creates the suggestion that there is more to be discovered about the landscape beyond what is gleamed from the initial viewpoint. It piques the interest and curiosity of those visiting the site and prevents them from completely comprehending the space. Bent paths, changes in topography and shrubbery obstructing views are common ways that mystery is created in a space (Kaplan and Kaplan 55-56).

Legibility was stated as the ease that a visitor has in understanding and remembering a landscape. It should be well organized and contain unique features that aid in navigating the landscape. These features help visitors find their way into, around and out of a space. High legibility facilitates the creation of mental maps of the site (Kaplan and Kaplan 55).

Visual Stewardship Theory of Natural Area Design

Design of naturalistic landscapes presents the landscape architect with some unique factors to consider. Landscapes with high ecological quality are often viewed negatively; they are seen as messy and unkempt. Conversely, many landscapes that are viewed as well-ordered do not contribute to the ecological health of an area. They often are of little use to wildlife because they lack good habitat. Typically, natural area design is guided by one of three aesthetic theories: scenic aesthetic, ecological aesthetic and the visual stewardship aesthetic (Sheppard 151).

The scenic aesthetic creates natural areas that match with public perception of what nature should look like. Unfortunately, the public often has an inaccurate idea of what constitutes a healthy natural area. These designs often result in a landscape that is not ecologically healthy and does not provide suitable habitat for wildlife. The scenic aesthetic makes the assumption that what looks good to humans will also be good for wildlife (Sheppard 153). A typical example of this aesthetic is a city park. The trees and grass give it the appearance of nature, but how good is the wildlife habitat it offers?

The ecological aesthetic focuses on the ecological health of the design. This aesthetic is the opposite of the scenic aesthetic. It assumes that what is ecologically health will be appealing to visitors once they have been educated about how the site functions. The ecological aesthetic theory requires that the general public be highly educated in ecology. Since this is simply not the case in most instances, landscapes designed with this theory are often not visually preferred by visitors (Sheppard 157-158).

The visual stewardship aesthetic theory is a hybrid of the scenic and ecological aesthetic theories. It does not focus on the naturalness or formality of a design. Instead, the design focus is on whether or not the landscape appears to be maintained and cared for by humans. People like to see that others have a respect for and attachment to a site. This theory strives to create an ecologically healthy landscape that is visually preferred by visitors (Sheppard 160). It is this theory that guided the design of this creative project.

University of Michigan landscape architecture professor Joan Iverson Nassauer has developed some interesting strategies for landscape design that support the use of the visual aesthetic theory in the design of this project. She stated that the majority of the general public does not understand the patterns and cycles of natural systems. It is, therefore, up to the designer to create a culturally familiar language that translates these ecological patterns into “words” that are understandable to almost anyone who visits the space (Nassauer 197). Nassauer asserted that a designer should "frame ecological function within a recognizable system of forms (Nassauer 198)." Typically, people look favorably upon landscapes that appear neat and orderly. These spaces clearly are under the care of another human (human intention). Nassauer stated " Designing ecosystems so that people will recognize their beauty and maintain it appropriately may depend upon including design cues of human intent. (Nassauer 199)" Cues of human intent are a means of transforming expectations of how a landscape should appear and facilitate the acceptance of a "messy" ecosystem. The intent is to link the "messy" space with culturally accepted cues that the space is being cared for (Nassauer 203).

<u>Midwestern Cues of Human Intent:</u>

- Mowing
- Flowering Plants and Trees
- Wildlife Feeders and Houses
- Bold Patterns
- Trimmed Shrubs, Plants in Rows, Linear Planting Design
- Fences, Architectural Details, Lawn Ornaments, Paintings
- Foundation Plantings

(Nassauer 203-204)

This creative project heavily relied on the use bold patterns as its language to translate messy ecosystems into places that are accepted by the general public. Nature's geometric patterns are highly familiar, if only at the subconscious level, to people of all ages and will easily facilitate ecosystem acceptance.

Geometric Patterns in Nature

Nature is the first and foremost designer and the beauty created by nature is unsurpassable. There is genius in all of nature's creations. Man can stand to learn a lot from what nature has to teach. The greatest mistake any young designer could make would to be to ignore the lessons of nature's designs. Renowned landscape architect, Laurie Olin believed that to be a successful designer, one must have a wide base of knowledge about form from which to draw. He compelled designers to study nature so as to build their repertoire of form (Olin 77).

Although the forms and geometry of nature seem complex, deeper investigation reveals economic simplicity. They are born out of the need to create order and conserve energy. In essence, beauty is the by-product of flora and fauna adapting to survive and function as efficiently as possible. Nature has simply developed the most workable solutions for obtaining air, water, light and nutrients. Form most certainly follows function.

All of nature's designs are composed of a limited palette of six forms: sphere, polygon, spiral, helix, meander and branch. These six patterns appear again and again in various combinations throughout nature. By understanding these six shapes, one can better understand the structure of all living beings. These shapes are often the building blocks of more complex forms and each pattern offers its own unique benefits. Nature chooses the pattern that best resolves the particular issue at hand ("The Shape of Things"). This section will investigate these six forms and provide insight into the functions they serve in nature. It will also discuss mathematical patterns that reveal themselves in nature.

Nature’s Six Patterns

Sphere

One of the most recognizable examples of a sphere in nature is the raindrop. As with all of nature’s forms, it is an efficient means to an end. In this case, the sphere is the most compact shape a fluid can form. It requires the least amount of surface material for a given volume. Soap bubbles are a good way to show a sphere’s efficiency. Spheres show up in many other ways. Cherries and crabapples exhibit a spherical quality. Many species of algae are spherical (figure 2.1). The shape of an egg is reminiscent of a sphere. The curved shape of an egg serves its function very well. An eggshell is made of calcite crystals. When pushed from the outside of the shell (as would happen when the egg is incubated by the mother) these crystals are pressed tighter together, creating an incredibly light structure capable of withstanding great force without breaking. When pushed from the inside (as would result from a duckling ready to be born), however, it easily gives way. Eggs also minimize surface area, which reduces heat loss. Porcupine fish also create a spherical form when they inflate to ward off predators (“The Shape of Things”).

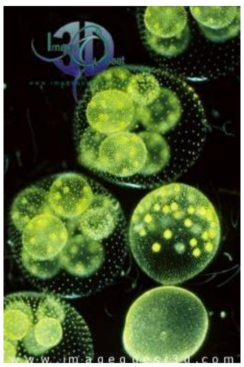


Fig. 2.1. Algae

Polygon

When bubbles (spheres) pack tightly together, they create a series of rounded polygons. The pressure of the bubbles causes them to join three at a time. This is referred to as a three way joint. The angle between these joints is


Fig. 2.2. Snowflake

typically 120 degrees. These joints combine with other three way joints to create six sided figures (hexagons). Each bubble retains the same amount of air, but less surface area is now needed to enclose it. Ice crystals are also shaped like hexagons. Because snowflakes are simply a compilation of several ice crystals, they, too (figure 2.2), will be six-sided. Ice crystals are formed by the effect of lowering temperatures on water


Fig. 2.3. Honeycomb

molecules and not by pressure. Wasps and bees exhibit polygons in their nests (figure 2.3). Hexagons create nests that require less material and work to build. It is an efficient way of partitioning that also saves energy. Flora and fauna use three way joints in their vascular systems. They are a resourceful way to create relatively short distance for fluid to travel. The basic structure of many marine organisms is the polygon ("The Shape of Things").

Spiral

Spirals appear prolifically in nature. Mollusk shells typically take on a spiral


Fig. 2.4. Chambered nautilus shell

form. The chambered nautilus is the example most often cited to illustrate the spiral pattern of shells (figure 2.4). Chambered nautilus shells exhibit astounding consistency. Each spiral is typically 6% larger that the one before. This consistency is key to maintaining the shell's shape. The horns of rams also grow as spirals. The shape results from a difference in the rate of growth of the horn. The outside of the horn grows faster than the inside and forces the horn into the spiral.

Plants also exhibit spiral forms in the way their leaves and flowers grow. The florets in sunflower heads spiral out from the flower's center. This pattern is created

Fig. 2.5. Sunflower

when new florets in the center push older florets to edges. As with the nautilus, the key to preserving the spiral shape is consistency. All of the florets (even though the are not the same size) grow at the same rate and the spiral grows with it (figure 2.5). This pattern is present in all composite flowers (daisy, fleabane, black-eyed susans, etc.). The arrangement of leaves around many plant stems is also a spiral ("The Shape of Things").

Helix

The helix is a three dimensional spiral and functions in much the same way. The most well known helix is perhaps that of the DNA structure. The DNA helix allows a very narrow, but condensed form. DNA is 50 million times as long as it is wide. This creates a very efficient means of conveying genetic information. The tendrils of vines are also helices (figure 2.6). They are used to aid the vine in getting closer to a supporting structure. When necessary, the tendril can contract and bring the vine closer to the structure. Pea vines wrapping around a pole is also an example of a helix. Helices are also used by plants as means of seed dispersal. Maple and Tree-of-Heaven seeds are shaped like helices (figure 2.7). This creates an aerodynamic propeller that keeps the seeds airborne for long periods of times. The seeds are then spread for greater distances and prevent offspring from competing with parents for space, light and nutrients. Helices are used by trees to reinforce the walls of the tubing of their vascular system against collapse ("The Shape of Things").

Fig 2.6. Grapevine

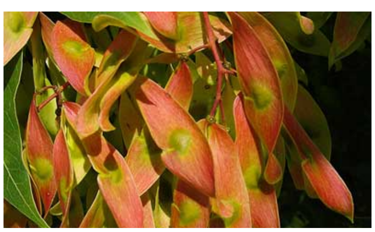


Fig. 2.7. Tree-of-heaven

Meander

Meanders are closely related to spirals and helices. They are all essentially entities with one surface growing longer or faster than the other. The meander results in a form that curves around itself. This pattern is very good at covering space, but does so in an indirect manner (Stevens 92-94). The movement of a snake across the desert sand reveals a meander. It is formed as the muscles of the snake alternately tighten and relax along each side. Likewise, the way a moray eel swims through water is a meander ("The Shape of Things"). The pattern a river makes as it flows across the landscape is perhaps the most recognizable example of a meander (figure 2.8). River meanders form a smooth elliptical pattern created by the force of flowing water. The meander is created as the river flows faster on the outside and slower on the inside. The faster side is deeper with greater erosion. Conversely, the slower side is the benefactor of this erosion. It is shallower as a result of receiving this sediment. Meanders allow for a smooth, uniform river free of sharp changes in direction. The bends of a river are predictable (Stevens 93). A river free of man's tampering will never run straight for more than 10 times its width ("The Shape of Things"). The bend's radius is nearly always equal to two to three times the river's width. The river's wavelength, the distance between bends, is equal to seven to ten times the width (Stevens 94). Glaciers, which are essentially rivers of frozen water, also exhibit meander patterns ("The Shape of Things").

Fig. 2.8. River meander

Branch

Trees, florets of clover, roots of plants, and blood vessels are all examples of how nature employs the branching form. Branching is the way that nature has devised to solve structural problems. Branches must be able to su7pport their own weight. If there are fewer branches, there is less stress on the organism.

There are four common ways that branching appears in nature: explosion, double

Fig. 2.10. Explosion

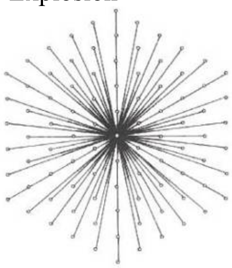


Fig. 2.10. Double Explosion

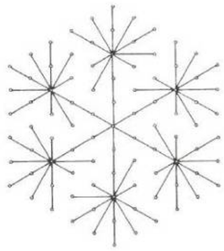


Fig. 2.11. Bilateral Symmetry

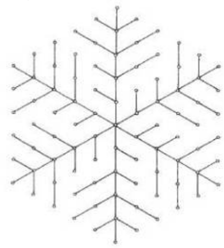
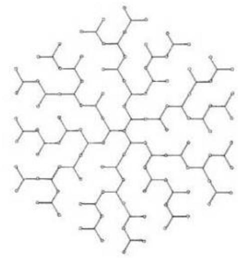


Fig. 2.12. Forked



explosion, bilateral symmetry and forked (Stevens 39-40). With the explosion type of branching, each leaf has its own branch. This pattern minimizes distances between the center of the plant and outer leaves. Because this would require a lot of wood, it is not prudent for trees. However, it does suit a species such as buttonbush (figure 2.13). It provides an excellent way to attract pollinator insects. Likewise, the double explosion pattern is not a good choice for trees, but is well suited to the wild parsnip (figure 2.14). The number of blossoms this form accommodates make it highly striking to insects. Just as Tree-of-Heaven uses helix shaped seeds to aid in dispersal, milkweed, dandelions, goatsbeard and dogbane use explosion shaped seeds to aid in seed dispersal. Attached to the seeds are explosions (parachute-like fluff), that easily catch wind and can float for great distances on their currents. Goatsbeard illustrates how a pattern can repeat itself within a plant (figure 2.15). The flower of the goatsbeard has the explosion pattern. Likewise, the

Fig. 2.13. Buttonbush

Fig. 2.14 Wild Parsnip

Fig. 2.15. Goatsbeard

seeds show the explosion pattern. Cocklebur seeds are explosions with small hooks to attach themselves to the pelts of animals. A bilaterally symmetric explosion has the same number of minor branches evenly arranged on each side. This pattern would require less wood and is commonly seen in conifers (figure 2.16). It presents itself

Fig. 2.16. Conifer tree

in both the branches and the way in which needles grow from these branches. The final type of explosion pattern are branches that are made of forks or three way joints. This type of configuration is commonly seen in deciduous trees. It provides the shortest route from trunk to leaf and requires the least amount of wood. The leaves of trees also reflect the branching patterns. Each leaf has a major veins fanning out from a stem. These major veins have a lacy network of vascular tissue connected to them (figure 2.17). The branching gets smaller

Fig. 2.17. Elephant ear leaf

and smaller as it moves farther away from the source. Central vessels are biggest because the flow in these vessels is greatest. This lacy network is attached to the stomata (the lungs of the leaf). This system is the best way for all parts of the tree to receive nourishment. Many of nature's components do double duty. Large veins not only carry fluids, but also are also structural supports. They help leaves stay flat and increase their ability to catch sunlight needed for energy. Branches with forks are used as the vascular systems of most all living things and behave as is observed in trees ("The Shape of Things").

<u>Mathematical Patterns Found in Nature</u>

Just as there are many geometric patterns in nature, there are also mathematical patterns that abound in nature. The Golden Section and Fibonacci numbers are two of the most intriguing and studied of nature's mathematical patterns.

The Golden Ratio (also known as the Golden Mean)

By studying the following diagram, one can understand the Golden Ratio. Line a+b is known as the golden section. It is a line divided into two parts. The Golden Ratio says that the line is divided in such a way that the ratio of the longer segment (a) to the whole (a+b) is equal to the ratio of segment a and b. If segment a is equal to 1 then b will be equal to 0.6180339887… Likewise segment a+b is equal to 1.6180339887… and is also known as the golden section. The Golden Ratio or section is often represented by the Greek letter φ (phi). $\Phi = (1+\sqrt{5})/2 \approx 1.6180339887$. The Golden Rectangle is another important concept that is derived from this ratio. The ratio of the side of the golden rectangle is equal to 1.618. By nesting a series of Golden Rectangles, one can create a logarithmic spiral. This type of spiral is seen in many of nature's patterns. The chambered nautilus shell is an example of such a spiral (Pratt, "Patterns in Nature").

Fibonacci Sequence

The Fibonacci sequence is a series of numbers that is closely related to the Golden Section. It begins with 0 and 1. Successive numbers are determined by adding the two preceding numbers (0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377…) The Fibonacci sequence can be used to find the Golden Section ("Fibonacci Numbers in Nature"). The ratios of two consecutive Fibonacci numbers begins to converge on the reciprocal of the Golden Section (Pratt, "Patterns in Nature").

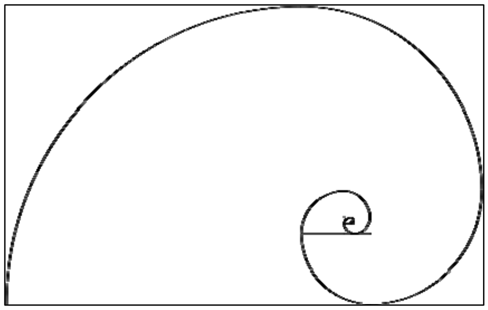


Fig. 2.18. Fibonacci spiral

The golden ratio and Fibonacci numbers continually show up in nature's patterns. They can be observed in the spiral pattern of florets on composite flowers, the arrangement of leaves around a stem, and the spiral of the chambered nautilus shell. Spirals influenced by the golden ratio and Fibonacci numbers are called Golden Spirals (figure 2.18). Golden Spirals are also called logarithmic or equiangular spirals. A key characteristic of these spirals is that they do not alter their shape as their size increases (Pratt, "Patterns in Nature").

The plant kingdom readily offers up examples of Fibonacci numbers and Golden Sections. The number of petals on nearly all flowers is a Fibonacci number.

3 Petals : lily, iris

5 Petals: buttercup, wild rose, larkspur, and columbine

8 Petals: delphinium

13 Petals: ragwort, corn marigold, cinegaria

21 Petals: aster, black-eyed susan, chicory

34 Petals: plantain, pytethrum

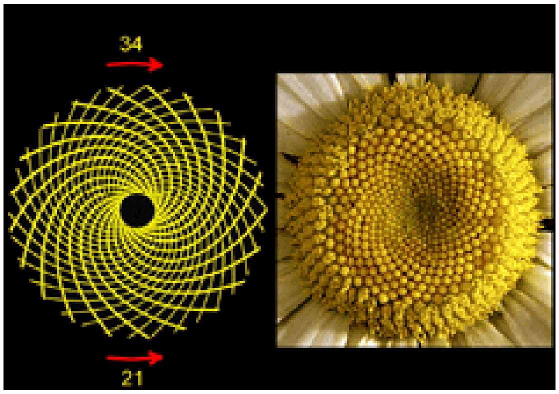
55, 89 Petals: michelmas daises and the Asteraceae Family

("The Fibonacci Numbers and Golden Sections in Nature")

Another way that Fibonacci numbers and Golden Ratios are observed in nature is through phyllotaxis. Pyllotaxis is the distribution or arrangement of leaves on a stem and the mechanisms that govern this arrangement. It is often used by botanists and mathematicians to describe the repetitive arrangement of leaves, petals, seeds, florets and branches in nature (Adams 217). Plants arrange their leaves in such a way to assure maximum sun exposure. This is typically achieved by spiraling leaves around a stem and the Golden Ratio can be observed in this arrangement. When a circle is divided into Golden Proportions (the ratio of the arc lengths is equal to the Golden Ratio), the angle of the arcs is 137.5 degrees (Parveen, “Fibonacci in Nature”). Many plants position adjacent leaves around a stem at this angle, as well. Looking at a plant from above, one can see that leaves are not arranged directly on top of one another. This arrangement of leaves around a stem exhibits Fibonacci numbers. To observe this, one starts with a leaf and counts the number of times a stem is encircled before one reaches a leaf directly below it. Likewise, one must also count the total number of leaves one encounters along the way. This can be done clockwise and counterclockwise around a stem. In this example, the stalk is circled two times and passes five leaves in the counterclockwise direction. In the clockwise direction, the stalk is circled three times. The three numbers (in this case 2, 3 and 5) observed are usually consecutive Fibonacci numbers. It is estimated that 90% of all plants exhibit this pattern of Fibonacci numbers (Pratt, “Patterns in Nature”).

Pinecones, sunflowers and pineapples have spiral packing patterns that exhibit Fibonacci numbers. The scales of pinecones spiral away from the center stem. The numbers of spirals in the clockwise and counterclockwise direction are consecutive

Fibonacci numbers. Likewise, the florets on the head of sunflowers (and other composite flowers) form intersecting spirals running in the clockwise and counterclockwise directions (figure 2.19). Some species have 34 and 55 spirals (other combinations are 21, 34 and 55, 144). Again all of these combinations are consecutive Fibonacci numbers. Pineapples tend to have 13 rows of scales that slope to the right around the fruit and 8 rows sloping to the left (Pratt "Patterns in Nature").



These are just a few of many examples of the Golden Ratio and Fibonacci numbers in nature. It is believed that these numbers can be applied to the growth patterns of all living things. Fibonacci numbers are often referred to as Nature's numbering system (Parveen, "Fibonacci in Nature"). Obviously, living things do not comprehend the sequence they so readily embody. As with most all of nature's patterns, flora and fauna are just trying to grow in the most efficient way possible. Fibonacci numbers and the Golden Ratio are a result of organisms responding to physical constraints such as space and light requirements (Parveen, "Fibonacci in Nature"). Despite the fact that plants are not intentionally using these mathematical patterns, they appear so frequently that it inspires great mystery and intrigue of a possibility of a deeper meaning to these patterns. Some will even go so far as to assert that these patterns are proof of a higher power.

Jens Jensen and His Design Trademarks

Jens Jensen was a Danish-born landscape architect who worked predominantly in the American Midwest (Illinois, Indiana and Wisconsin) during the late 19^{th} and mid 20^{th} centuries. In Ellison Bay, Wisconsin, he established "The Clearing" as a school to train landscape architects. Jensen's childhood days spent exploring the Danish countryside inspired an early affinity for nature and its rhythms (Grese 2). His agricultural training's emphasis on botany, chemistry, and soils proved very useful to Jensen's later work. His education also focused on people's connection to and understanding of a place and its broader context (Grese 5). Jensen's educational background became one of the building blocks from which he developed a passion for nature and regional landscapes and for evoking this same response in others. Trips to the Illinois and Indiana prairie fueled his passion for study of the landscape and the native plants of the region (Grese 7). This background made Jensen one of the leading "prairie style" landscape architects. Jensen often worked with O.C. Simonds, another acclaimed prairie landscape architect, and prairie-style architects such as Frank Lloyd Wright and Louis Sullivan. The prairie style was guided by three basic principals: conservation (preservation), restoration, and repetition. This style was characterized by the use of prairie flora and landforms. Horizontal lines were often used to pay homage to the flat prairie landscape. Designs were meant to be representations of the prairie and not literal recreations (Grese 45). Prairie-style designs were often intended to teach visitors about the natural history of the region and inspire appreciation for nature (49-50).

Just as prairie-style landscape architecture contained elements that set it apart from other design philosophies, the designs of Jens Jensen often carry certain elements that set them apart from other prairie-style designs: the use of native plants, his handling of open space, attention to light and shadow, the way visitors move through the space, “prairie” rivers, stonework, “player’s greens”, vegetable gardens, and an emphasis on time and change.

Jensen was known for his use of native plants (Grese 151). He continued to employ horticultural varieties when clients desired them, but made sure that each design contained native species (Grese 152). He made a strong effort to model nature’s planting structure and used plants in ways in which they would occur naturally. Jens was deliberate in his plant choices. Often, he would study the site conditions in order to chose a species which would thrive under those conditions. His choice of tree and understory species mimicked associations found in nature and he often planned for the succession of species in his designs. This does not say that Jensen neglected to artfully apply the plants to the landscape (Grese 154). He also believed that plants should be allowed to maintain their natural form and resisted the use of topiary and pruning (Grese 156).

Another trademark of a Jensen design was his use of open space. Open space helped create the feel of the open prairie. In order to create the illusion of a larger space, he often was very deliberate with the views he created for visitors. For example, a central open space would have a wooded border. Paths were placed in the wooded border and mindfully placed gaps in vegetation to provide visitors with views onto open spaces. He often would bend open spaces so that they would disappear behind vegetation. This created the illusion that the space continued indefinitely. The border vegetation often featured a series of coves and promontories and created a feel that more space existed behind the trees and shrubs. Another common feature was the “long view”. This consisted of a linear space with trees and shrubs on either side and often showcased something of interest (i.e. an estate). When properly sequenced with driveways, vegetation and structure placement, the “long view” was also used to create a sense of mystery (Grese 160). Another common trademark of Jensen’s designs was the use of small “rooms” connected by narrow paths to the large open spaces. The large open spaces were considered public space. The small “rooms” were intended to provide a visitor with the privacy necessary for such activities as meditation, but also allowed them the opportunity to view the activities taking place in the meadow (Grese 163).

Jensen was very cognizant of the effects of light and shadow in a design and carefully used both (Grese 165). He oriented the axis of many open spaces so that the sun would rise on one end and set on the other. Paths and roadways were often designed to include what Jensen called “sun openings”, small clearings that created a transition from shade to sun and vice versa (Grese 166). He believed that paths and roads should be in shadow and look onto sunny open areas. Paths rarely passed through the sunlit open areas, rather they wound through the shaded borders (Grese 167).

As with many other components of design, the way a visitor moved through a space was very important to Jens Jensen. Paths consisted of gently sweeping curves. He detested straight lines and felt they were only to be used when order was absolutely necessary (i.e. a formal rose garden). Placement of the curves was deliberate and had to match topography, vegetation or historical context (Grese 168). He would create mystery in his designs by placing vegetation on the inside of curves. This technique provided a reason for the bend in the road and implored visitors to explore what was beyond the bend (Grese 169).

The use of broad, flat bodies of water, named “prairie rivers” by the designer, is a highly identifiable feature of a Jens Jensen design. Prairie rivers were meant to typify the prairie wetlands that were present in areas surrounding Chicago. Stratified stonework that often created the backdrop of these waterbodies was meant to symbolize bluffs formed as Midwestern rivers cut through limestone. Many of the waterways began on shady, rocky ledges just as a natural spring would emerge from an aquifer (Grese 172). The small streams would then grow into large, prairie rivers lined with several wetland species (Grese 173).

Another highly identifiable feature of a Jens Jensen design was the exacting stonework found around council rings, streams and other structures meant to imitate natural limestone bluffs. The horizontal bands of limestone were meant to evoke the flat expanses of prairie from which he garnered much inspiration. This stonework could be found around swimming pools, bordering “prairie rivers” and creating waterfalls (Grese 174).

The only structural element that Jensen was known for using consistently in his designs was the council ring, which consisted of a circular stone bench with a fire pit in the center. They were intended to be gathering spots where all are to be treated equal. He tended to place the council rings on the edge of wooded areas looking outward on to a view (Grese 177).

Some of Jensen’s designs incorporated spaces for outdoor dramas, or as he often termed them, “player’s greens.” They did not have stages and seats, but were designed as natural spaces for performances. Typically, they were little more than a clearing on the edge of a wooded area (Grese 178).

Although Jensen preferred natural gardens, he would include in his designs small areas that would accommodate formal flower and vegetable gardens. Theses gardens were often separated from the natural garden spaces by walls or shrubbery. Vegetable gardens held a spot of particular fondness in the heart of Jens Jensen. He felt that raising vegetables was one of the most valuable ways to help people understand nature and appreciate the source of their food. Children's vegetable gardens were often a component of his designs (Grese 180).

A final signature of a Jensen design was his emphasis on time and change in the landscape. This was often expressed in three forms: capturing the sense of a moving or changing landscape, daily and seasonal variation and planning for succession (the growth and change of vegetation) in the landscape. He was particularly enthusiastic about expressing the effects of changing sunlight and seasons (Grese 182). To him, a landscape was completely different throughout the day and the seasons. Whereas some designers focused on creating an unchanging space, Jensen embraced the opportunities created by the movement of sun through a space and the seasonal changing of vegetation. He often designed paths that were meant to showcase the rising and setting of the sun (Grese 183). His selection of vegetation was a deliberate statement meant to highlight specific qualities of a season like fall color, spring wildflowers or the branching pattern of a tree (Grese 184). Jensen's later work particularly focused on the idea of landscape succession. He wanted his design to grow and evolve and felt that his work was just a starting point for nature (Grese 186).

Jensen was dedicated to preserving and improving native landscapes and hoped his designs would illustrate the beauty of nature to anyone who visited them. "For

Jensen, this was not merely a profession; it was his religion. To him, the garden was a sermon, speaking of harmony with God's out-of-doors. Perhaps more successfully – certainly more fervently – than his contemporaries, he merged his work as artist, conservationist, ecologist, and teacher (Grese 61)." His philosophies and design style hold great merit and applicability to the design of this creative project. They served to guide many of the decisions that culminate in the final product.

Center for Earth and Environmental Sciences (CEES)

Indiana University – Purdue University, Indianapolis (IUPUI) website stated that it is home to the Center for Earth and Environmental Sciences (CEES). Housed in the University's Department of Earth Sciences, the CEES is an environmental research facility that aims to encourage environmental research, science education and public service. One mission of the center is to increase understanding of science and the environment through activities that highlight their relevancy to students. In order to fulfill this mission, the center created Discovering the Science of the Environment (DSE). The website also discussed DSE in detail. DSE consists of a mobile environmental education facility that travels to schools and provides free educational programs to students. The programs are targeted at 4^{th} to 9^{th} grade students and teachers in Marion, Boone, Hamilton, Madison, Hancock, Shelby, Johnson, Morgan, and Hendricks Counties and meet Indiana State Standards for math and science education. They feature hands-on activities that facilitate a scientific investigation of nature. DSE offers curricula focused on water quality, prairie research, wetland exploration and woodland investigation. Each topic consists of several programs focused on that subject and has site requirements that must be met in order to host that program. These site requirements inspired the decision of what elements would be incorporated into the design of this creative project. It is envisioned that the design will have the ability to host each program offered by DSE.

Water quality studies consist of programs in Physical Assessment of Stream Water Quality, Chemical Assessment of Steam Water Quality and Biological Assessment of Stream Water Quality. These programs require access to a stream or flowing water. There is also a program in Groundwater Analysis and this requires an onsite groundwater well or pump accessible for programming.

Prairie research consists of programs in Prairie Soil Study, Prairie Ecosystem Investigation and Comparison and Plant Biodiversity, and Photosynthesis and require access to a prairie ecosystem or grassland.

Wetland exploration consists of programs in Wetland Ecosystem Investigation and Comparison, Wetland Soil Study, and Wetland Water Quality Studies (Chemical and Biological Assessment) and require access to a wetland ecosystem – pond, swamp, marsh, and bio-swales, but not rapidly flowing water.

Woodland Investigation consists of programs in Woodland Soil Study, Woodland Ecosystem, and Tree Monitoring. All require access to a forest or natural wooded area. Bird Observation requires access to a woodland/prairie ecosystem, bird feeders, or other bird viewing space ("Discovering the Science of the Environment").

These site requirements guided the design of this creative project. To provide a well-rounded environmental education experience, the design of the nature education center includes many of these curricula requirements. Because of the site's richness of amenities, students will be able to participate in nearly all lessons that DSE offers.

Additional site amenities provided the opportunity for additional lessons to be developed that are tailored to the site.

The following projects were chosen because they illustrate topics germane to the design of the creative project. By studying these real-life examples, the author was able to envision how these topics could be represented in the creative project.

Phalen Wetland Park

Location: St. Paul, Minnesota

Fig. 3.1. Phalen Wetland Park plan

Source: Dowdell, Jennifer; Harrison Fraker, and Joan Nassauer. “Replacing a Shopping Center with an Ecological Neighborhood." Places. 1 October, 2005. 15 February, 2009. <http://repositories.cdlib.org/cgi/viewcontent.cgi?article=1935&context=ced/places?

Fig. 3.2. Phalen Wetland Park

The online article, “Phalen Wetland Park: The Kind of Wetland You Could Take Home to Your Mother” by Tanya Olson-Kase discussd the wetland park. Phalen Wetland Park sits on the former site of the Phalen Shopping Center at the southern end of Lake Phalen (figure 3.1). The neighborhood surrounding the park is working-class, and many of its residents have lived there for over 50 years. Yards are tidy, well-tended and grass is always mowed. Before being razed, Phalen Shopping Center was run-down and suffering from low occupancy. An adjacent apartment complex was another eyesore drawing the concern of neighbors. The idea of a wetland amenity park was first suggested in 1986. It was hoped that the proposed park would provide habitat for migrating birds, act as a classroom to teach about wetlands, enhance nearby Lake Phalen and attempt to recreate the pre-development hydrology of the area. Many felt that the idea would meet with opposition because of the “messy” appearance wetlands tend to represent. However, careful design of the park helped to alleviate concerns about messiness. The project was completed in two phases beginning in June of 1995. Ecological and social success of the first phase was crucial to the project’s continuation into phase two. Social success of the project hinged on a positive perception and acceptance of the wetland by neighbors and those visiting the project. To achieve this aim, Joan Iverson Nassauer was brought in to design the park. Nassauer is known for her designs that facilitate positive perception of the environment by putting “orderly” frames around “messy” natural areas.

The park consists of eastern and western halves with a railroad berm running north and south down the middle. Each half contains a shallow, permanent pool of water. Visitors first experience the park’s western half and it is the one that most informs the design of this creative project. Its design has a familiar sub-urban feel and puts “orderly” frames around nature. Examples of such frames include: swaths of mowed turf, a circular boardwalk (figure 3.2) that allows visitors to approach the water, a path to reach the railroad berm and an observation area to view the site’s flora and fauna. The wetland and existing forest remnants are contained within these frames and are protected from human impacts. The railroad berm allows visitors to view and enjoy certain aspects of the site, but not enter them. The eastern part consists of a forested area that buffers the neighborhood from visitors, open water, a shrub-scrub wetland, strips of native emergent, wet meadow, mesic and upland vegetation.

This site was valuable because it demonstrates Joan Iverson Nassauer’s principles of “orderly frames” around a “messy” ecosystem and how they can lead to a positive perception of natural areas. This creative project was based on such principles, and proof of successful design application was encouraging and educational.

Marian College EcoLab

Location: Indianapolis, Indiana

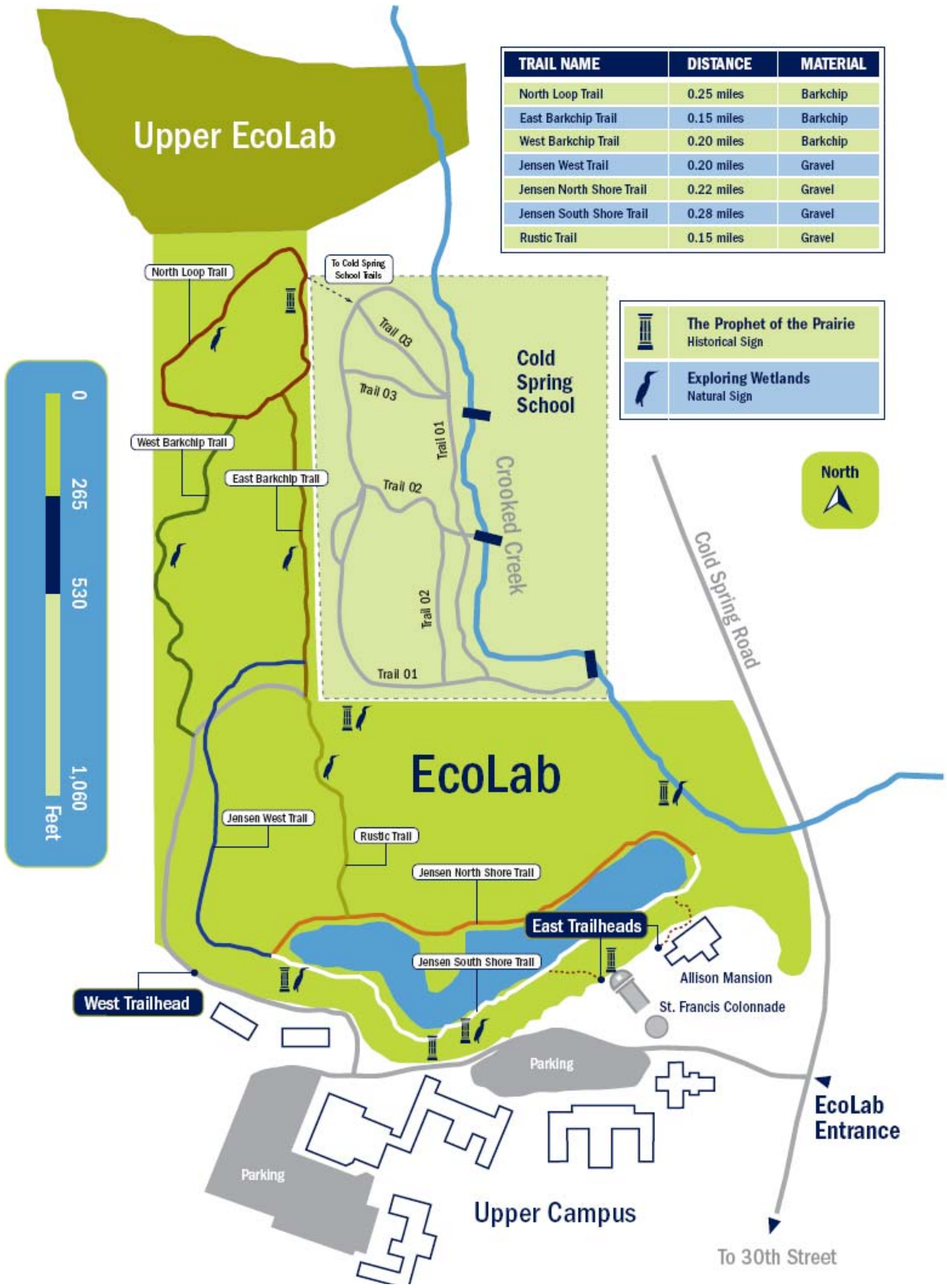


Fig. 3.3. EcoLab Map

Source: “About the EcoLab: Visiting Us.” Marian College EcoLab. 2006. 23 March, 2009. <http://wetland.marian.edu/about_visiting.shtml>

EcoLab on-line resources provided a wealth of information regarding its lay-out, site amenities and images of the facility. Located in the northern part of the campus of Marian College, the EcoLab is a 55-acre environmental education laboratory and classroom (figure 3.3). The facility contain over 260 native plant species, over 60 non-native species, over 160 bird species and mammals such as beaver, muskrat, mink and red fox. It exhibits a variety of topographies: bluffs, wetlands (30 acres of marsh, fen, forested wetland, sedge meadow and swamp), lowland forest, prairie and riparian.

Until recently, the EcoLab grounds were used only intermittently by Marian College students and faculty. In 2000, associate professor of biology Dr. David Benson initiated an ecological restoration of the facility. High on the priority list was removal of invasive species such as honeysuckle, buckthorn and Asian bittersweet. The EcoLab was officially dedicated on November 2, 2002 and has since received grant money to continue with restoration of the site and to improve the environmental education opportunities. EcoLab is used for a variety of educational purposes. Marian College students use the EcoLab to learn about ecological restoration and design, teaching environmental education, zoology, botany, ornithology, ecology, restoration ecology and conservation biology. It is also used to teach environmental sciences to children K-12, college students from other schools and members of the local community. EcoLab staff led field trips consisting of two components: service projects and theme-orientated lessons. Service projects consist of either exotic species removal, native plant species installation or native plant seed collection and sowing. Theme-oriented lessons involve learning about either native and non-native species, wetlands or beavers. The EcoLab is also open for use by the general public.

A portion of the EcoLab is comprised of the former estate of the founder of Allison Transmission and the Indianapolis 500, James A. Allison. The estate was designed by Jens Jensen and contained many of his signature elements. The EcoLab's trails are located on Jensen's original roads. Jensen elements still visible in the EcoLab include:

- Native plants: witchhazel, *Sagittaria*, *Hibiscus*, hawthorn, elderberry, dogwood, etc.
- Architectural structures: stone bridges, pergolas, spring houses, limestone benches and stairs
- Water features: ponds and half-moon pools (figure 3.4 and 3.5)
- Council rings: only the brick is present, but there are plans to restore it
- Meadow/prairie: the "Clover Meadow"
- Formal gardens separated from the naturally designed spaces: the garden is south of the estate and colonnade (figure 3.6). The natural gardens are north of the estate.

Fig. 3.4. North Shore

Fig. 3.5. Half-moon Pool

Fig. 3.6. Jensen Designed Colonnade at the Facility

IslandWood

Location: Bainbridge Island, Washington

Fig. 3.7. Marsh Ecosystem

Fig. 3.8. Classroom Complex

"The mission of IslandWood is to provide exceptional learning experiences and to inspire lifelong environmental and community stewardship."

A visit to the facility and the facility's website were the source of the following information. IslandWood is a 225-acre pioneering environmental education facility that offers programs catered towards children, graduate students, teachers and the general public and seeks to inspire stewardship of the community and the environment. It strives to use nature as a classroom to provide a hands-on education catering to many different learning styles and integrates science, technology and the arts. IslandWood aspires to lead by example in terms of teaching others to act more responsibly towards the environment. The facilities all practice composting, recycling, energy conservation, harnessing and using alternative energy and contains several elements that facilitate sustainability.

The site contains a stream, a four-acre pond, 62 acres of marsh wetland (figure 3.7), a bog, second-growth forest, ravine, a harbor with access to a marine estuary and plentiful flora and fauna. There is also a Living Machine (a facility that uses plants and other biological processes to treat wastewater), a welcome center, several trails, lodges, a conference room, dining hall, art studios, classrooms (figure 3.8), and a friendship ring (a covered outdoor amphitheater with a fire pit). The plan resulted from two years of research, focus groups, community meetings, and visits to reputable nature education facilities. Mithun architects (with help from area children) designed the educational structures, trails and field structures. Landscape architecture students from the University of Washington participated in design charrettes with 4^{th}, 5^{th} and 6^{th} graders to gain insight into the types of design elements the children would like to see in the facility. The children conveyed a desire for the inclusion elements that facilitated adventure-based learning.

IslandWood's innovative and immersive educational experience provided tremendous precedent for the success of similar nature education facilities. Although this creative project was not of the same scale or breadth as IslandWood, much can be learned from the benefits and design of hands-on, adventure learning facilities.

Site Location Maps

Fig. 4.1. Site Location Map – Regional Scale

Source: “MapQuest Maps.”MapQuest. 21 September 2008. <
http://www.mapquest.com>

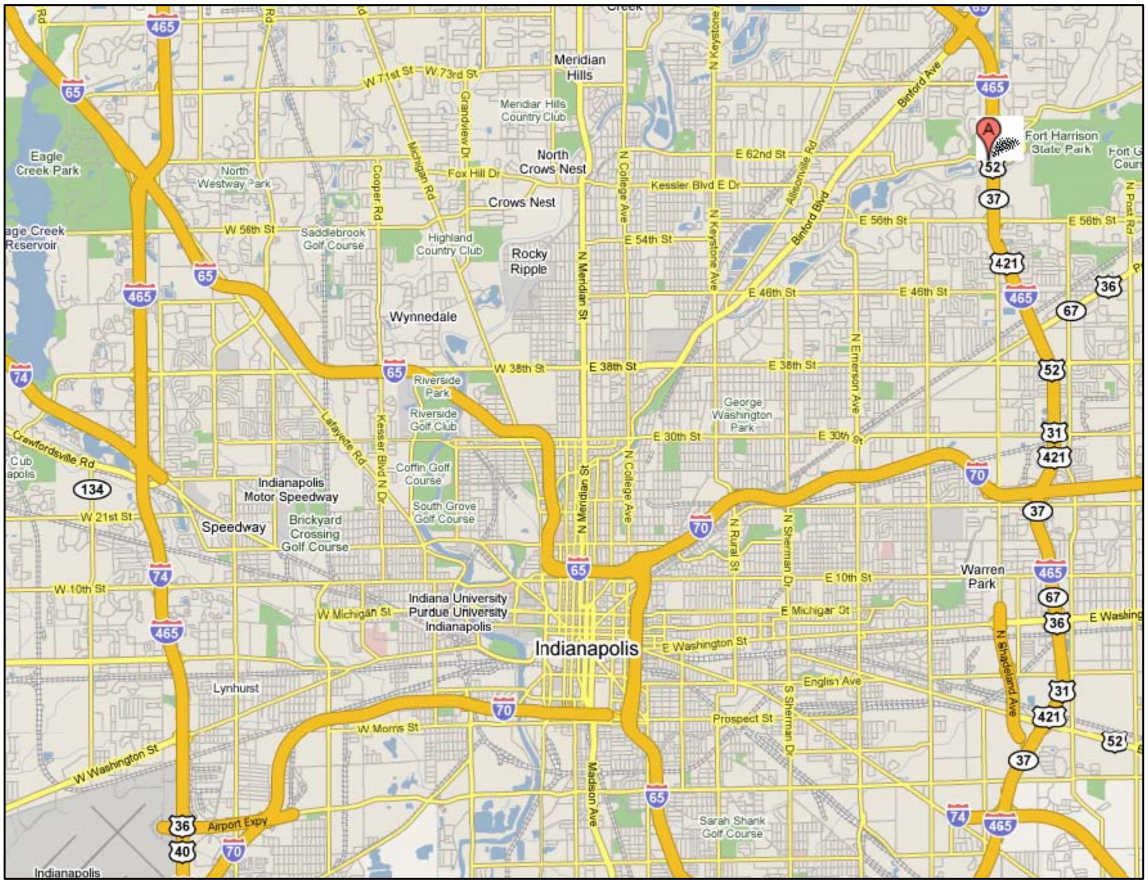


Fig. 4.2. Site Location Map – City Scale
Source: "MapQuest Maps." MapQuest. 21 September 2008.<http://www.mapquest.com>

Site Selection

Several factors were considered in the selection of a site suitable to the needs of this creative project. It was desired that the site be 50-75 acres in size with large areas of relatively flat land suitable for trails, outdoor classrooms, a nature education center and the creation of savannah-like spaces. Variation in topography was desired, but not required. The site also needed to possess existing natural areas or be suitable for the creation of natural areas and this area should have a wild, "weedy" appearance. It was considered important that the site have an existing transportation infrastructure that made it easily accessible for visitors. Because of the educational component of the project, it was important that it nestled in a residential area and adjacent to or within walking distance of an elementary or middle school.

Originally, a different location was chosen to be home to this creative project. Due to several reasons, it was decided that another site would be more suitable to the vision of this project. The site that was eventually chosen, Skiles Test Nature Park, came to the attention of the designer during a charrette organized by Ball State's College of Architecture and Planning Indianapolis extension in conjunction with the Great Indy Neighborhoooods Initiative. The designer was a member of the team focused on design of the neighborhood's parks and greenspaces, specifically Skiles Test Nature Park. Interviews were conducted with a group of residents from the area and insight was gained into their wants and needs for the park. The familiarity of the park gained during this exercise illustrated the ways in which this site fulfilled the design vision for the creative project.

Area History

The area surrounding the park was rural farmland until the 1950s, when the interstate was constructed through the area. Construction of the roadway was the catalyst for growth in the area. Families moved away from the urban Indianapolis area, yet could still quickly commute to jobs there. Moving to the area was a move to the suburbs, complete with spacious lots, less pollution, better schools and a quieter way of life. The 19060's through 80's were the period of the greatest residential growth for the area. By the 1990's, the area began to decline as commercial and retail establishments began to move farther north to communities like Carmel and Fishers. As a result, the area began to see a decline in its own commercial and retail interests. In April 2005, residents concerned about this trend formed the group Binford Redevelopment and Growth, Inc. (BRAG) in an effort to save their dying community (figure 4.3). A grant from the Great Indy Neighborhoods Initiative has allowed the group to take steps towards realizing their vision (Binford Redevelopment and Growth Area Quality of Life Plan 11-12).

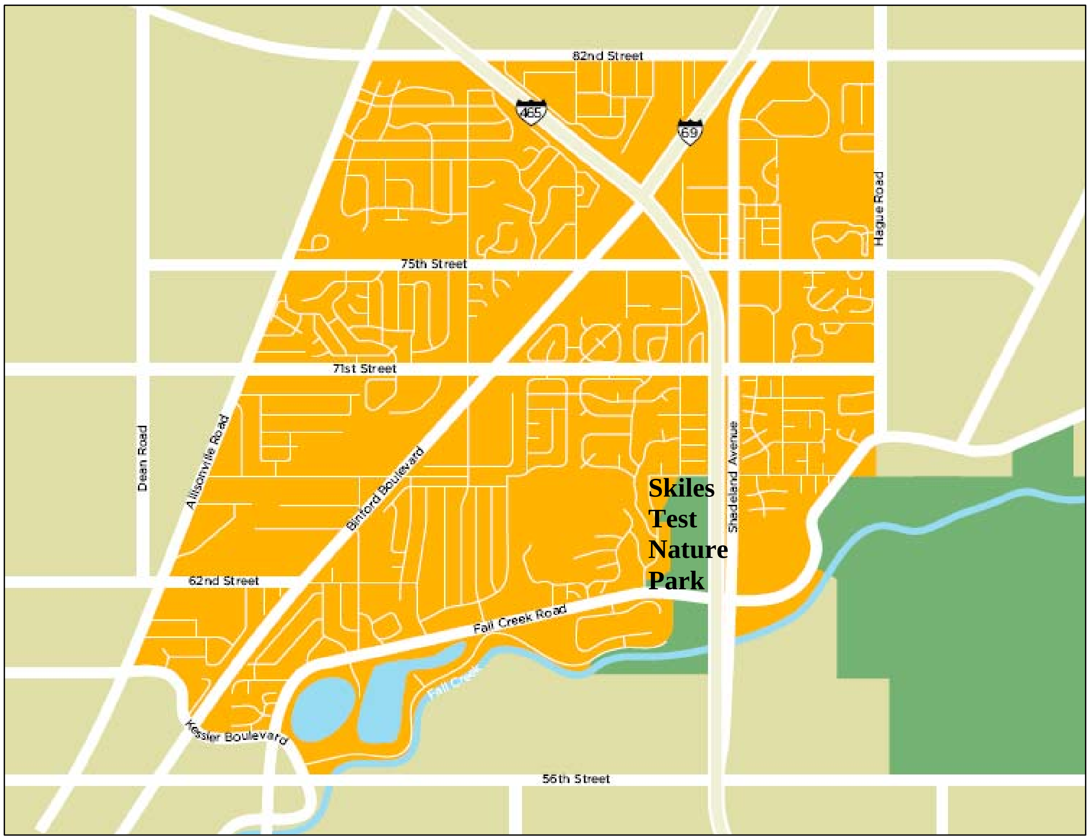


Fig. 4.3. Binford Redevelopment and Growth (BRAG) Area Map.
Source: Binford Redevelopment and Growth Area Quality of Life Plan. Great Indy Neighborhoods. 2008. 10.

Site History

The Center for Earth and Environmental Science's online resources provided the following information regarding the history of this site. The site, as was much of the land surrounding it, was once farmland. It was purchased by local wealthy businessman, Skiles Edward Test. Skiles Test owned land (approximately 700 acres) in northeast

Marion County. He and his wife moved to the farm in 1913. Skiles Test was known to be a bit eccentric. His property once had an Olympic-sized swimming pool with diving platform and a miniature railway that traversed the land. The Test home itself was known as “The House of Blue Lights” due to the fact that it was adorned all year in blue Christmas lights. Because the structure was visible from the Interstate, it became quite infamous. Test lived on the land until his death in 1964. The heirs of Skiles Test eventually bequeathed the land to the City of Indianapolis, Board of Parks and Recreation. All structures on the site were demolished by the Board of Parks and Recreation in 1978.

Fig. 4.4. Site Aerial Photograph – 1937

Source: “Skiles Test Nature Park.” IUPUI Center for Earth and Environmental Science. 21 September 2008. <http://www.cees.iupui.edu/service_learning/images/2005%20skiles%20service%20learning%20map%201937.jpg>

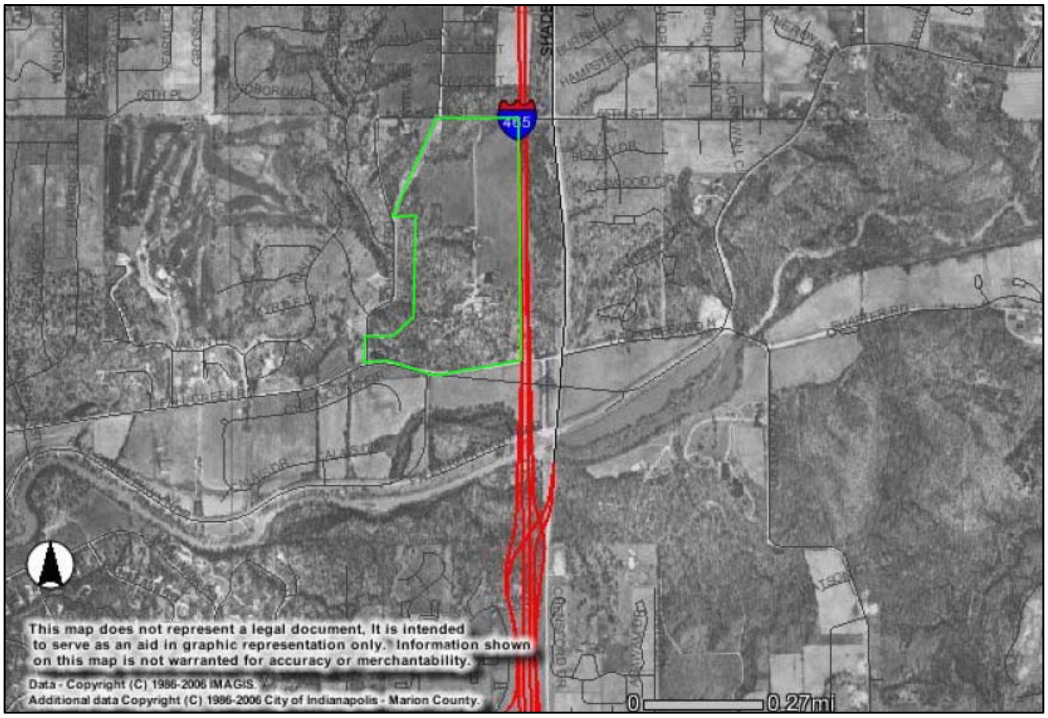


Fig. 4.5. Site Aerial Photograph – 1962

Source (Fig. 4.5, 4.6 and 4.7): “Indianapolis General Data Viewer.” City of Indianapolis. 21 September 2008. <http://imaps.indygov.org/prod/GeneralViewer/viewer.htm>

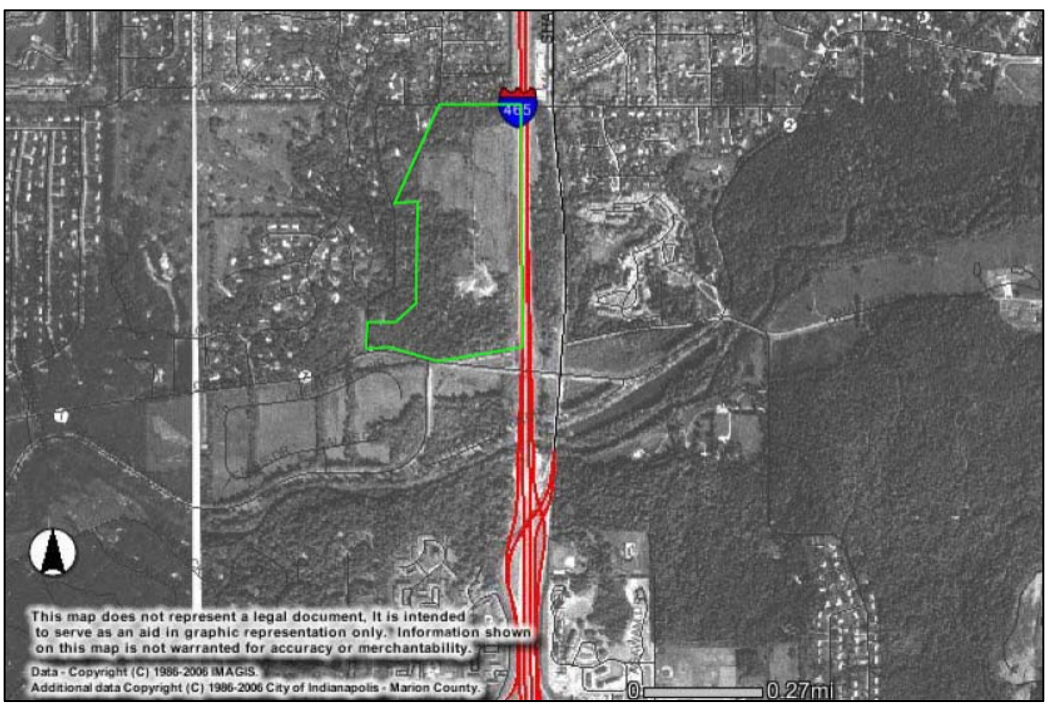


Fig. 4.6. Site Aerial Photograph – 1978

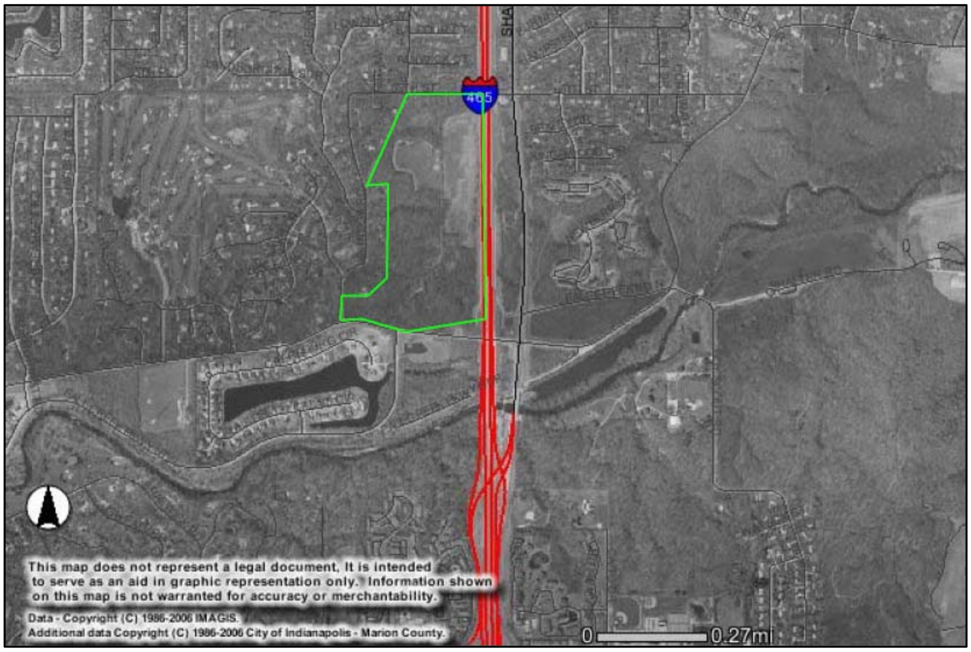


Fig. 4.7. Site Aerial Photograph – 1999

Fig. 4.8. Site Aerial Photograph – 2002

Source: “Skiles Test Nature Park.” IUPUI Center for Earth and Environmental Science. 21 September 2008.

<http://www.cees.iupui.edu/service_learning/images/2005%20skiles%20service%20learning%20map.jpg>

Demographics

The area adjacent to Skiles Test Nature Park is predominantly middle-class and Caucasian. The population is equally split between males and females. The median age distribution in the area surrounding the park is comprised of the age group 30-40 and 40-50. Average family size is 3.27 members. The rate of children in poverty for the MSD of Lawrence Township (the school district the park is located) is 8.3%. This number is possibly a reflection of areas well beyond the site than those adjacent to the park (Binford Redevelopment and Growth Area Quality of Life Plan 12).

Client and Users

Indy Parks and Recreation owns the site that will be home to the Skiles Test Nature Education Center. It is one of several natural resource areas located within the park system. These areas are relatively untouched and retain a more "wild" appearance. They offer visitors the opportunity to experience nature amid an urban landscape.

The nature park is located in an area of Indianapolis known as Binford Redevelopment and Growth (BRAG). BRAG is located in northeast Marion County and is bounded by on the north by East 82nd St., Kessler/Fall Creek Blvd on the south, Allisonville Rd on the west and Hague Rd on the east. The area is bisected by Binford Blvd., a major commuter corridor through northeast Marion County. BRAG has a population of approximately 35,000 residents. BRAG is one of several communities participating in the Great Indy Neighborhoods Initiative (GINI); a coalition of public and private groups working together to build better communities. BRAG's participation in GINI resulted in six topics of concern: business development, crime and public safety, pedestrian access and connectivity, schools, sense of community and parks and greenspace (Binford Redevelopment and Growth Area Quality of Life Plan 3-5).

The community's focus on parks and greenspace is of great interest regarding the creative project. BRAG and Indy Parks and Recreation have expressed interest in the development of a masterplan for Skiles Test Nature Park. Friends of Skiles Test Nature Park Advisory Board is a group of citizens that has determined what they believe to be appropriate uses for the park. The Board hopes the masterplan would develop educational assets in the park, increase amenities and design a Nature Center (Binford Redevelopment and Growth Area Quality of Life Plan 25-26).

It is anticipated that residents of the BRAG area and visitors to the Fall Creek Greenway will most heavily use this facility. However, it is hoped that park's unique design will make it a destination for visitors outside of the BRAG area. The park will also serve as an environmental education classroom to nearby Skiles Test Elementary School and other nearby schools. The design was geared towards serving an educational curriculum developed for 4^{th} -9^{th} graders, but it is believed that visitors of all ages could learn about nature's geometries.

Site Context

Location:

The project was located in what is currently Skiles Test Nature Park. It is an 80.9 acre facility located in northeast Marion county, Indiana. The park is bounded on the north by 65^{th} St., Fall Creek Road on the south, on west by Johnson Road, and I-465 on the east.

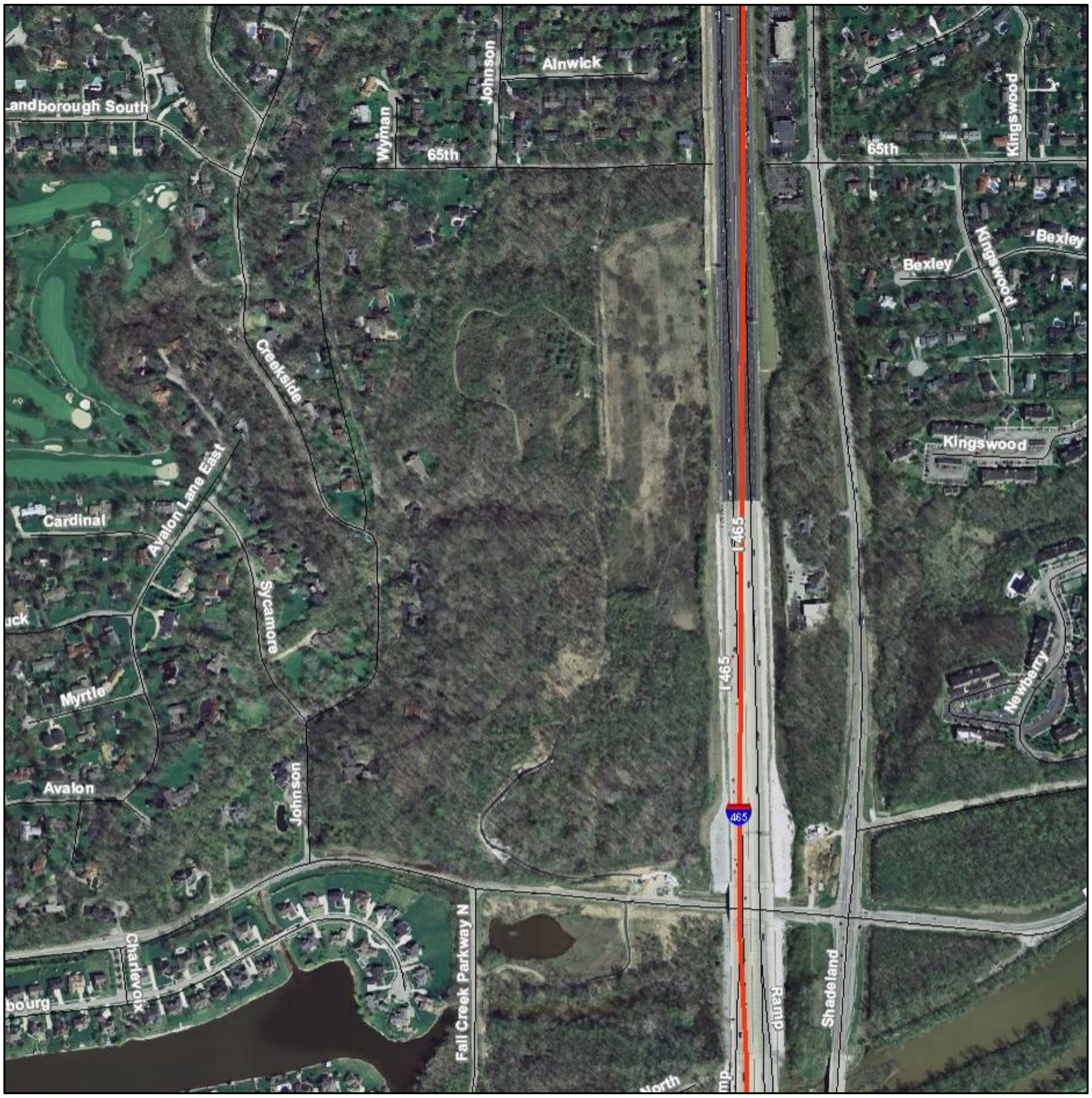


Fig. 4.9. Site Location Map – Site Scale

Source: "IndianaMap." Indiana University. 21 September 2008. <http://inmap.indiana.edu/viewer.htm>

Surrounding Area:

The northern and western boundaries consist of quiet well-established residential neighborhoods with many mature shade trees. The southern boundary consists of a well-traveled two-lane roadway that provides good access to the site. The park's main entrance is located on Fall Creek Road. The entrance is marked by a sign and a small parking lot that also serves as the northern terminus of the Fall Creek Greenway. It is unassuming and does little to attract visitors to the park. The interstate makes up the eastern boundary. The noise generated by the traffic is quite noticeable when in the park and was addressed in the park's redesign.

The site is located within a half mile of the White River and is part of a substantial tree canopy network through northeast Marion County. The network begins at Geist Reservoir and follows along the White River before dissolving into a developed, urban landscape. The location offers the opportunity to attract wildlife to it, a fact very beneficial to the creation of a nature education center. Wetlands are not highly prevalent in this area, predominantly being confined to areas adjacent to river.

The site is within walking distance of Skiles Test Elementary School. Several other schools are within close driving distance of the facility.

<u>General Characteristics</u>

The Center for Earth and Environmental Science's on-line resources provided the following information regarding general characteristics of the site. The park consists of 80.9 acres of land owned by Indy Parks and is a designated natural resource area. It is the northern terminus of the Fall Creek Greenway. Currently, there are two miles of trail that exist within the park. The site contains approximately 60 acres of upland forest located in the hills and ravines of the southern and western portions of the park (see figure 4.10). Wooded areas are also present in the flatter northern areas of the site. In 1995, 14 acres of prairie were planted on the east side of the park between the interstate and the former driveway. The eastern third of this section was left to succession. An additional seven acres on the west side of the park have been designated as a successional area as well. The site contains woody species such as: Eastern cottonwood (*Populus deltoids*), black walnut (*Juglans nigra*), Ohio buckeye (*Aesculus glabra*), burr oak (*Quercus macrocarpa*), red oak (*Quercus rubra*), chinquapin oak (*Quercus muhlenbergii*), white oak (*Quercus alba*), sugar maple (*Acer saccharinum*), American beech (*Fagus grandifolia*), sycamore (*Platanus occidentalis*), hackberry (*Celtis occidentalis*), and white pine (*Pinus strobus*). Herbaceous species on the site include: big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), Indian grass (*Sorghastrum nutans*), yellow coneflower (*Ratibiba pinnata*), purple coneflower (*Echinachea purpurea*), New England aster (*Aster novae-angliae*), bergamot (Monarda didyma), butterflyweed (*Asclepias tuberose*) and goldenrod (*Solidago* spp). It also has several areas that have been invaded by invasive species, most notably bush honeysuckle (*Lonicera* spp).

Fig. 4.10. Wooded and Open Space

The park, however, has a large fairly flat area of approximately 39 acres. It contains no wetlands. There is a pocket of somewhat poorly % slope (CrA) in the eastern area that has been planted as a prairie (figure 4.11) . The site has fairly steep topography on its southern and westerns edges. This topography creates some wonderful ravines that add visual interest to the park (figure 4.12).

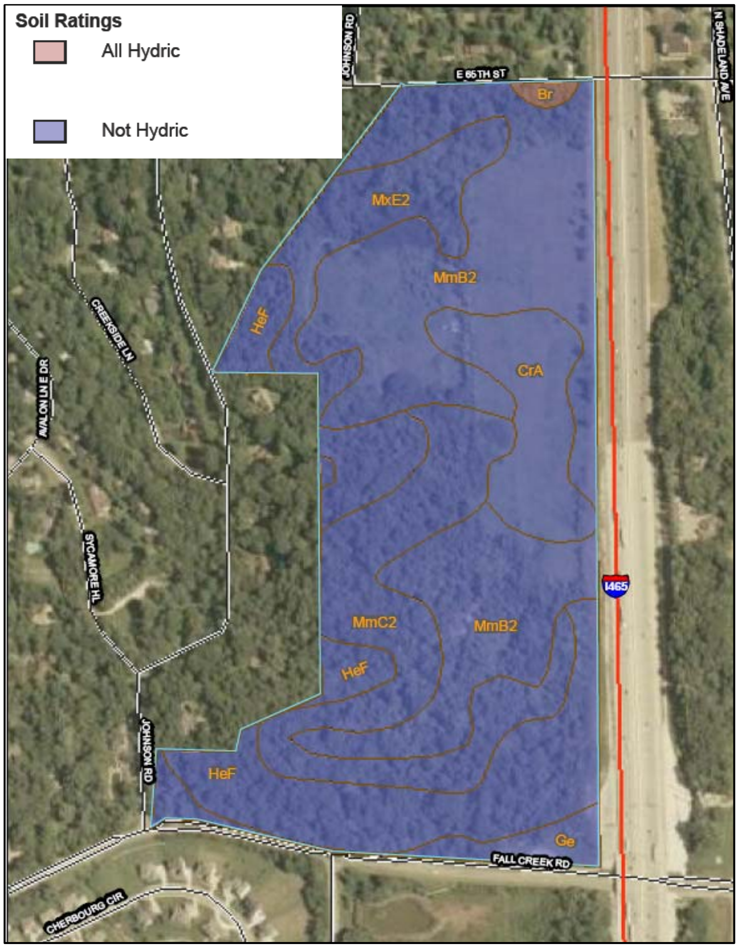


Fig. 4.11. Map of Hydric (Wetland) and Non-Hydric (Non-Wetland) Soils on Site

Table 4.1: Site Soils and Drainage Classes

Map Unit Symbol	Map Unit Name	Drainage Class
Br	Brookston silty clay loam	Poorly drained
CrA	Crosby silt loam, 0 to 2% slopes	Somewhat poorly drained
Ge	Genesee silt loam	Well drained
HeF	Hennepin loam, 25 to 50% slopes	Well drained
MmB2	Miami silt loam 2 to 6% slopes, eroded	Moderately well drained
MmC2	Miami silt loam, 6 to 12% slopes, eroded	Moderately well drained
MxE2	Miami complex, 18 to 24% slopes, eroded	Well drained

Source: "Web Soil Survey." USDA. 4 November 2008.
<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

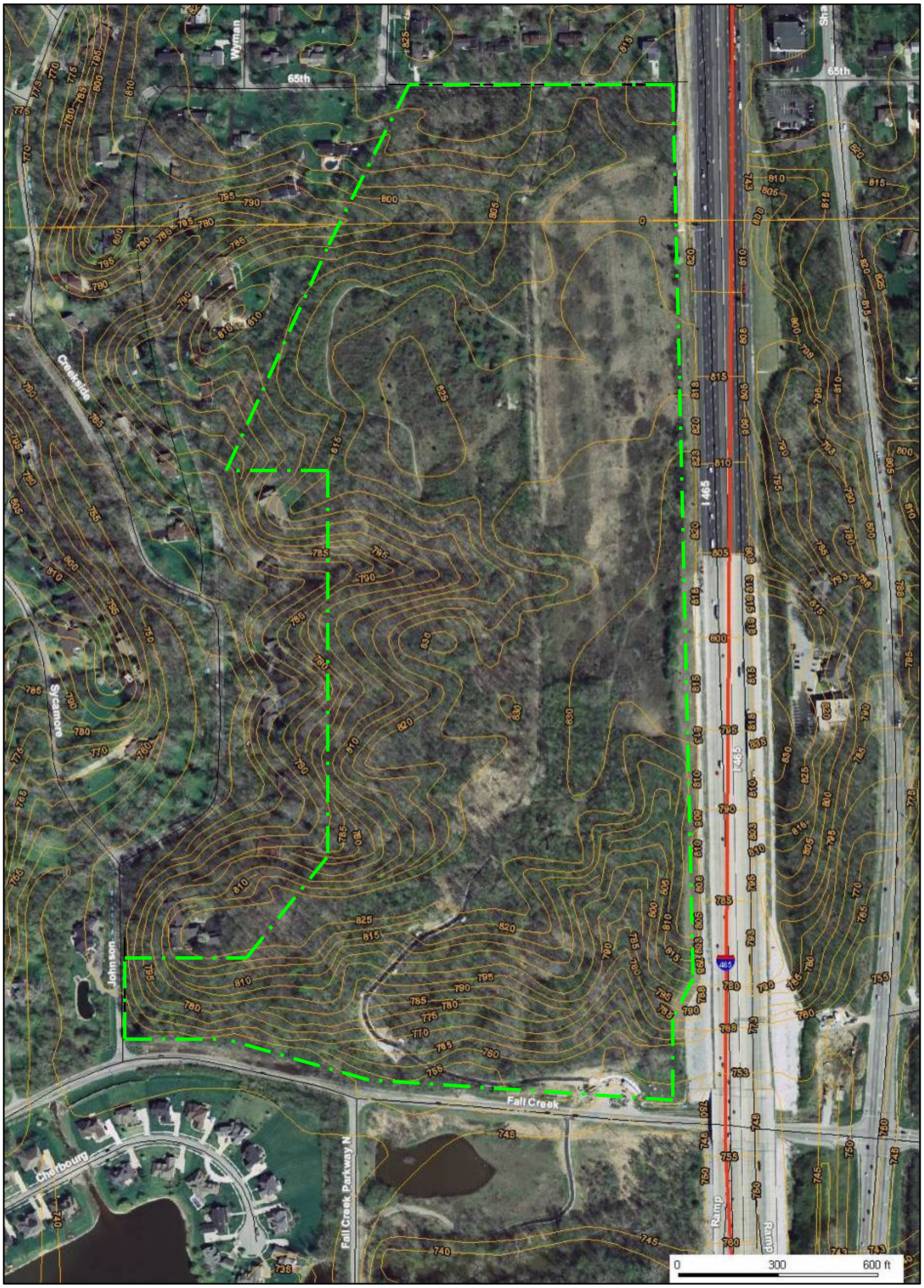


Fig. 4.12. Site Map – Topography

Source: “IndianaMap.” Indiana University. 21 September 2008. <http://inmap.indiana.edu/viewer.htm>

Area Amenities:

Fall Creek Greenway (links to Monon Trail and Bike Route 88

Ft. Benjamin Harris State Park

Hillcrest Country Club

Skiles Test Elementary School

Woollen's Gardens Nature Preserve

Site Opportunities and Constraints

Opportunities:

- Skiles Test Elementary School is located within a half mile.
- Fall Creek Trail leads to site.
- Part of a fairly substantial wildlife corridor.
- Existing "weedy" natural area.
- Very little existing evidence of human intervention on site.
- Close proximity to neighborhoods.
- Good transportation infrastructure to park

Constraints

- Close proximity to I-465.
- Traffic noise.
- Indy Parks may not have funding to carry out the plan.
- Parking is limited and not much room for bus parking.
- Northern access point is located in residential area.
- Due to site topography, the main park entrance is steep and not handicap friendly.

Site Analysis

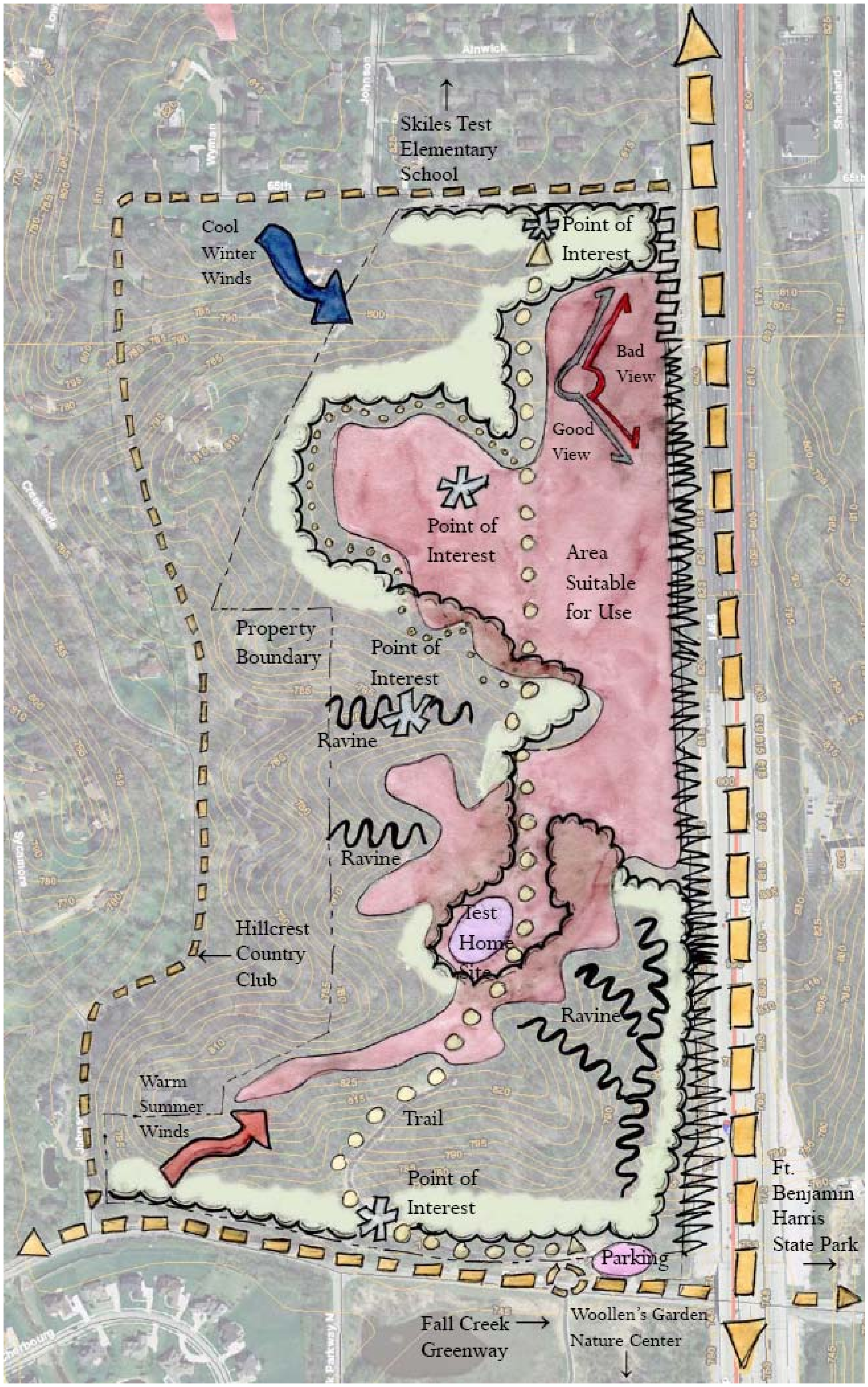


Fig. 4.13. Site Analysis

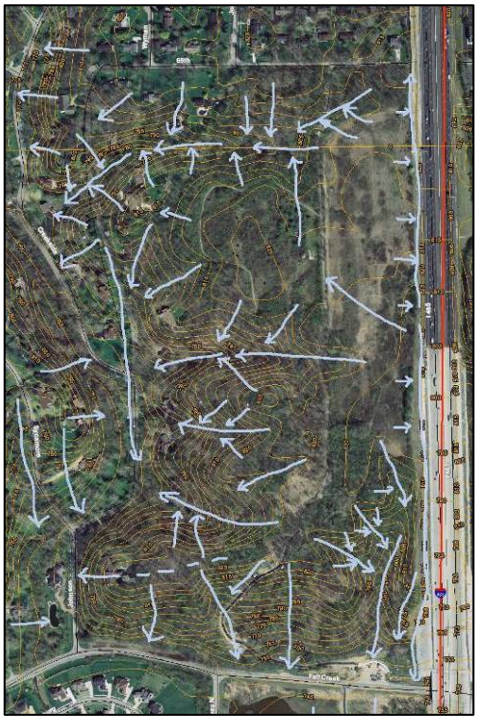


Fig. 4.14. Direction of Water Flow

Fig. 4.15. Drainage Ways on Site

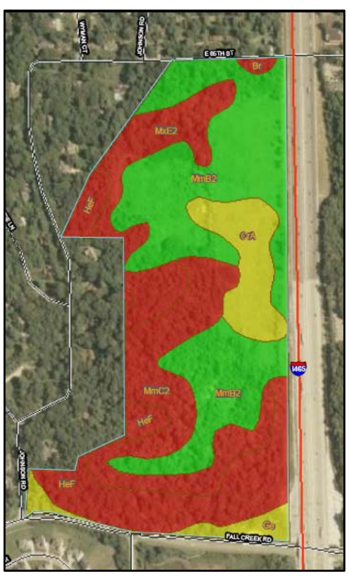


Fig. 4.16. Soil suitability for Paths.

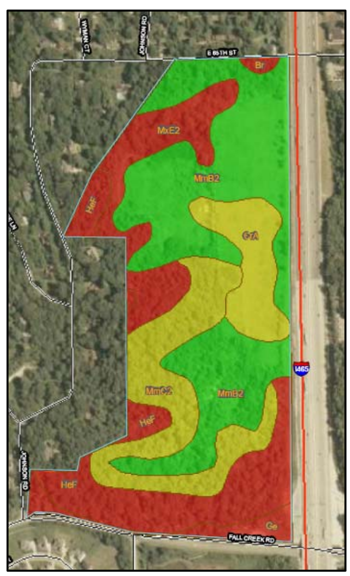


Fig. 4.17. Soil Suitability for Landscaping .

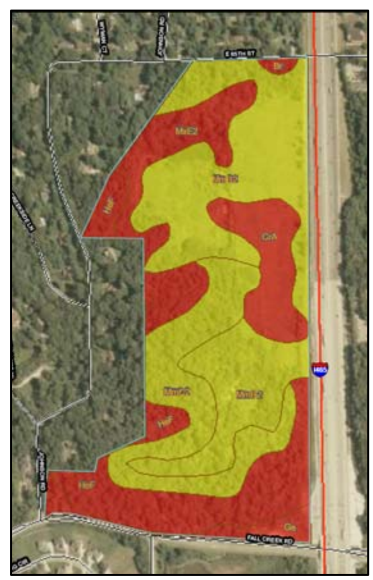


Fig. 4.18. Soil Suitability for Structures.

Very limited

Somewhat limited

Not limited

Source: "Web Soil Survey." USDA. 4 November 2008. <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

Circulation and Access

Although the site is adjacent to I-465, there is not an exit ramp at the intersection with Fall Creek Road. Visitors arriving to the site via interstate travel may experience some confusion and difficulty. The interstate ramp system that one must use to get to Fall Creek Road is rather confusing. Arrival at the site via Fall Creek Road is much easier and more pleasant. Sections of the roadway offer the user a scenic prelude to arrival at the park. Likewise, Johnson Road and 65th Street, the means of accessing the northern park entrance, are calm, tree-lined residential roadways. An existing paved trail leading from the southern parking lot acts as the main entryway into park. The trail meanders its way up to what was once the driveway to the Test home. The driveway acts as a north-south axis running through most of the park. It is paved, but not in good condition. Several other worn dirt trails also lead to the former driveway.

Chapter 5 – Programming and Preliminary Design

Goals and Objectives

This project began as a vague idea for a nature education center that would teach visitors about nature's pattern palette and would use these patterns to design a space that allow visitors to feel comfortable in nature. It was important to create a space that both humans and animals would want to visit. The focus on creating and enhancing existing habitat on the site was an important way to attract animals to the site. The following is an outline of the goals that guided the design of this creative project. Each goal is followed by several objectives that helped achieve the stated goal.

1. Design a nature education facility that teaches about nature and its geometric patterns.

- Use design elements that contain these geometric patterns:
  - Six mini-parks that each represent a distinct geometric pattern
  - Outdoor classroom that contains elements of each pattern to provide a comprehensive experience.
  - Fences and architectural details that reflect the pattern and inform the visitors they are in a distinct zone (mini-park dedicated to that pattern)
- Inform visitors about Fibonacci numbers in nature:

        - Create a garden dedicated to plants exhibiting such numbers in their structures.
    - Teach about nature's processes by including features that can be used in the development of an environmental education curriculum:
        - Pond
        - Prairie area
        - Rain gardens and bio-swales
        - Flowing stream
        - Wetland ecosystem

2. Facilitate a positive experience of natural areas:
    - Use nature's geometric patterns and Fibonacci numbers as a design language that puts an orderly frame around nature's "messy" ecosystems.
    - Include design features that act as "cues of human intent" and aid in creating a visually preferred landscape.
    - Incorporate findings of studies and theories regarding landscape preferences into the site design.

3. Foster a healthy ecosystem within project limits:
    - Design site to adhere to the Visible Stewardship Aesthetic principal of natural area design.
    - Enhance degraded ecosystems on site.
        - Habitat enhancement through planting design.
        - Design additional habitat types (wetland, pond, stream, bio-swale).

- Site design that seeks to be minimally intrusive to existing natural features and work in concert with such features.
    - Trails that require little disturbance to the landscape
    - Design elements that accentuate existing topography
    - Locating amenities in areas that have history of degradation and/or disturbance.

Design Features

- Entry/Gateway feature (Nasauer inspired)
- Fibonacci garden (Nature's pattern representation)
- Accessible entrance (Project goal)
- Zones representing each of the six geometries. The design and various elements of the zone will reflect the geometric pattern (Joan Iverson Nassauer inspired)
- Establish and enhance trail network (Project goal)
- Forest or natural wooded area – EXISTING, but will enhance (DSE requirement)
- Educational signage and way-finding (Project goal)
- Fences and architectural details (Joan Iverson Nasauer inspired)
- Flowing stream (Discovering the Science of the Environment (DSE) requirement)
- Wetland ecosystem – no running water (DSE requirement)
- Wildlife habitat enhancement through planting designs (Project goal)

- Prairie ecosystem or grassland – EXISTING, but will enhance (DSE requirement)
- Artwork on noise barrier along I-465 (Nassauer inspired)
- Indoor and outdoor (some covered) classroom space (Project goal)
- Resting/Meditation space (Project goal)

Preliminary Design Sketches and Concepts

The following are very rough concept sketches that used to illustrate early brainstorming sessions and show development of ideas for elements residing in each of the six pattern mini-parks.

Ideas for Polygon Mini-Park Elements

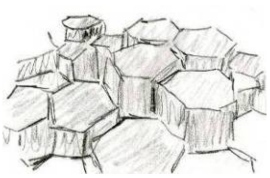


Fig. 5.1. Hexagon-shaped play area

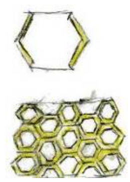


Fig. 5.2. Shelterhouse wall pattern

The hexagonal play area (fig. 5.1) was inspired by the Giant's Causeway located in Northern Ireland. The play structure design consisted of hexagon-shaped pieces of varying sizes and heights. The shelterhouse wall pattern (fig. 5.2) was inspired by a bee's honeycomb and further illustrates the occurrence of the polygon geometry.

Ideas for Sphere Mini-Park Element

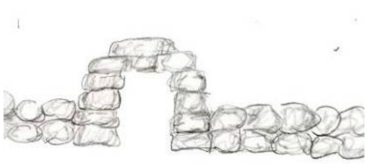


Fig. 5.3. Entryway to sphere mini-park

Fig. 5.4. Observation station

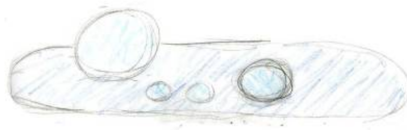


Fig. 5.5. Blue orbs floating in water

The entryway to the sphere mini-park (fig. 5.3) was designed to incorporate an arched gateway to highlight the strength of this geometry. The design of this space included a globe shaped observation station (fig. 5.4) to provide visitors a bird's eye view of the sphere mini-park and floating blue orbs (fig. 5.5) in the pond emphasize the geometry and memorialize Skiles Test.

Ideas for Meander Mini-Park Elements

Fig. 5.6. Meander boardwalk

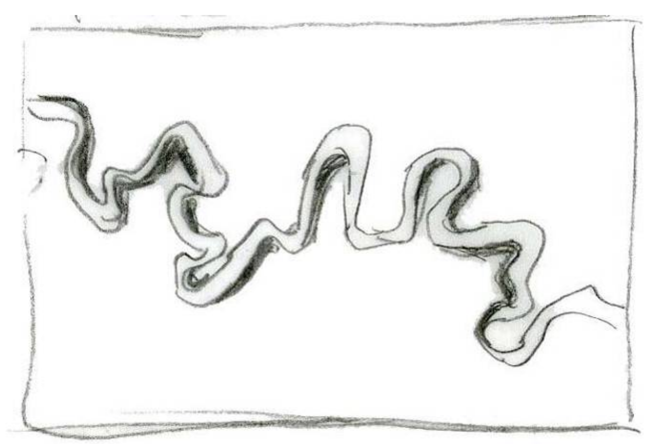


Fig. 5.7. Art installation for noisewall

The meander mini-park was designed to draw attention to the meander pattern by creating a boardwalk (fig 5.6) that meanders opposite to the stream in this area and allows visitors to become part of the undulating patterns. The existing noise wall (fig. 5.7) was used as a canvas for an aluminum art installation inspired by a natural rivers meandering pattern.

Ideas for Spiral Mini-Park Elements

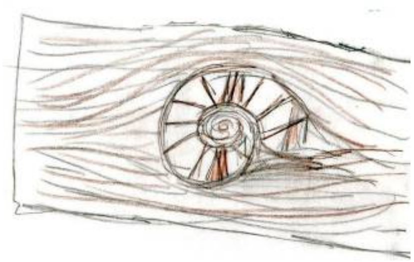


Fig. 5.8. Walkway detail

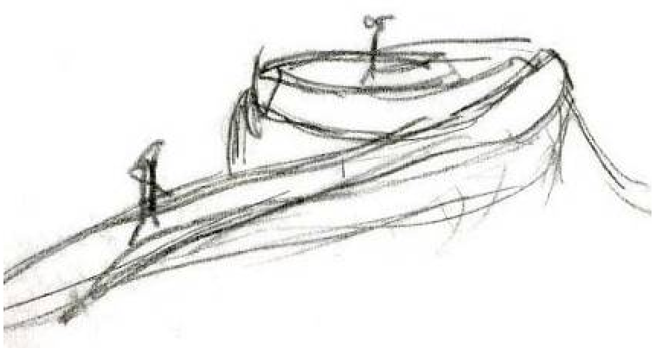


Fig. 5.9.
Spiral landform: profile view

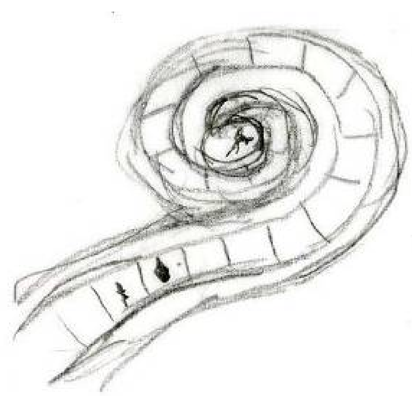


Fig. 5.10.
Plan view

The entry to the spiral mini-park was designed to include a spiral (fig 5.8) in the walkway leading the main feature of this area, a large human-made spiral landform (fig. 5.9 and fig 5.10). The landform was employed as a means of giving visitors a sense of prospect by allowing them to see the site from a higher elevation.

Ideas for Helix Mini-Park Elements

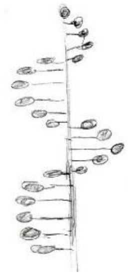


Fig. 5.11. Wind sculpture

Fig. 5.12. Vine covered pergola

The helix mini-park was designed with elements such as a helix wind sculptures (fig 5.11) to attract visitors eye and a pergola (fig 5.12) with helix shaped columns which could support vines that have helix-shaped tendrils.

Ideas for Branch Mini-Park Elements

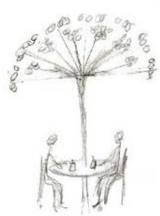


Fig. 5.13.
Picnic seating with canopy

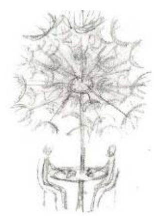


Fig. 5.14.

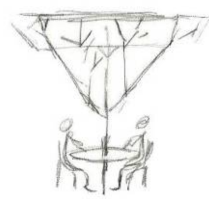


Fig. 5.15.

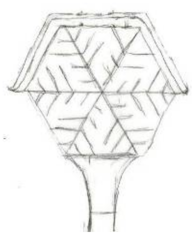


Fig. 5.16. Seating area and paving detail

Fig. 5.17. Paving detail

These design elements were included to demonstrate the branching patterns found in nature. The picnic seating (fig. 5.13, 5.14 and 5.15) used canopies that mimicked natural occurrences of the patterns. Likewise, seating area design (fig. 5.16) and paving details (fig. 5.17) were additional means of teaching the patterns

Design Concepts

Fig. 5.18. Concept 1

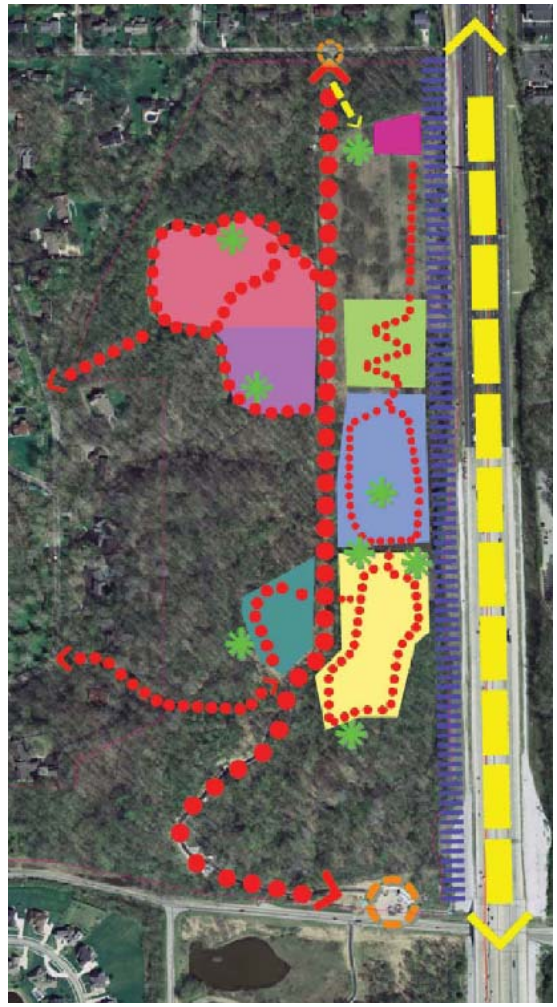


Fig. 5.19. Concept 2

- Branch Mini-Park
- Spiral Mini-Park
- Helix Mini-Park
- Meander Mini-Park
- Sphere Mini-Park
- Polygon Mini-Park
- Welcome Center

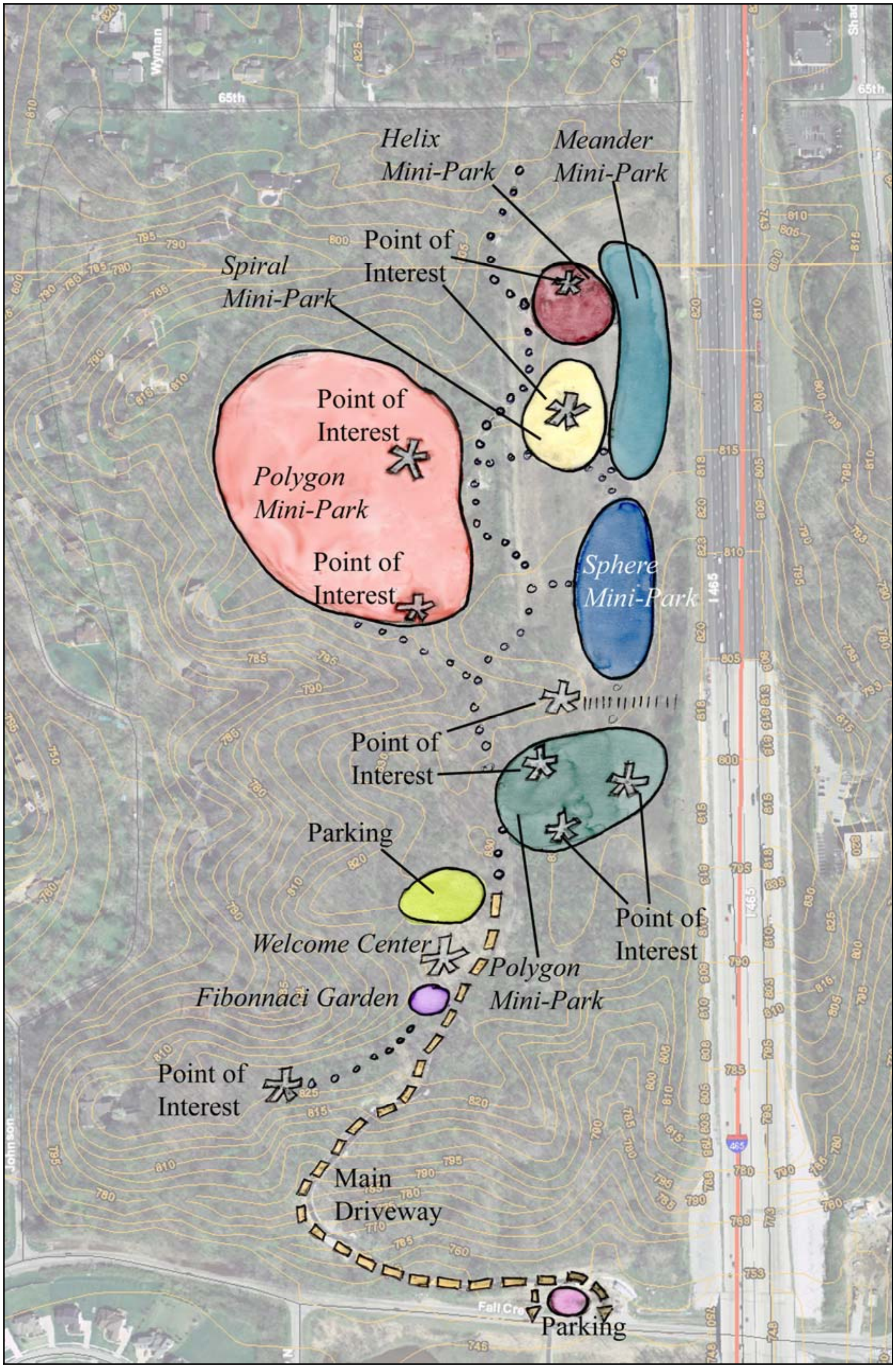


Fig. 5.20. Preferred Concept

Design Components and Inspirations

This creative project resulted in the design of a nature education center dedicated to teaching visitors about nature's geometric pattern (see figure 6.13). The following is a narrative the author developed to be included in literature about the site. The narrative describes to visitor what they can expect to experience when visiting the site and explains site amenities.

<u>Welcome Center and Fibonacci Garden</u>

Fig. 6.1. Detail of Welcome Center

The park's main drive leads up to a Welcome Center (fig. 6.1). The Welcome Center orientates visitors to the site and educates them about the geometries they will experience in greater detail at the center.

The Welcome Center is located on the former site of the Skiles Test home, and its unusual shape piques visitor curiosity (figure 6.2). The Fibonacci Garden, influenced by the spiral formed by the nesting of Golden Rectangles, is located next the Welcome Center and contains plants exhibiting Fibonacci numbers in their petals and flowers. This pattern exists prolifically in nature in forms such as chambered nautilus shells and rams horns. The building and garden compliment each other and reinforce the occurrence of the spiral geometry. Bio-swales in the parking lot cleanse stormwater flowing off the pavement and teach visitors about the natural processes at work to accomplish this.

Fig. 6.2. Welcome Center

<u>Main Path</u>

A path originating from the parking lot beckons visitors to explore the site. The winding path creates a sense of mystery intended to draw people into the nature center. It acts as a “vine” running north-south through the site with “tendrils” branching off that lead visitors to the six mini-parks located in the site. Each mini-park is dedicated to a distinct geometric pattern: polygon, sphere, meander, spiral, helix and branch.

<u>Polygon Mini-Park</u>

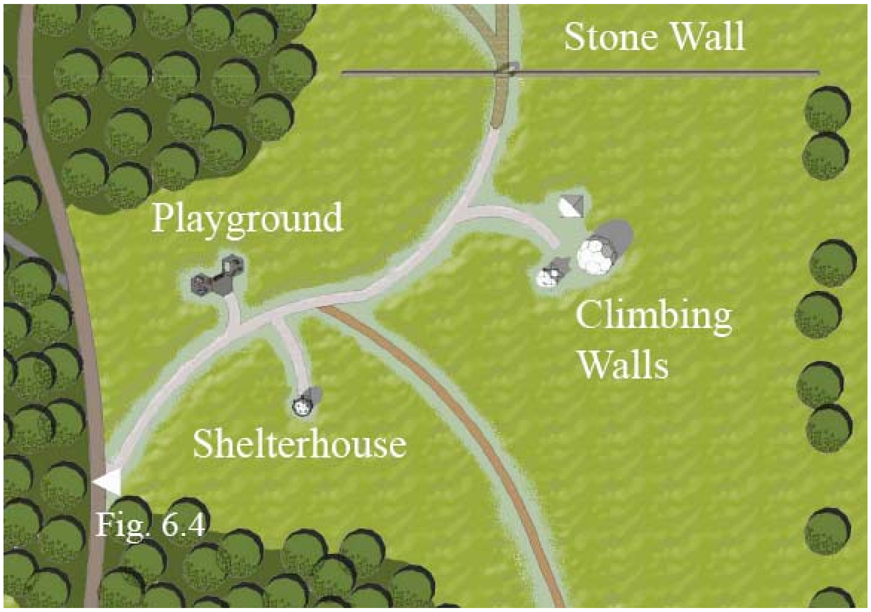


Fig. 6.3. Detail of Polygon Mini-Park

Fig. 6.4. Polygon Mini-Park

The main path veers around a massing of trees and implores a visitor to investigate what lies ahead (figure 6.3). The design signals to visitors they were entering the polygon mini-park through design elements found in the space. Key elements in the mini-park include a path of hexagonal pavers, a polygon climbing wall, a playground featuring polygon-shaped elements and a hexagon-shaped shelterhouse (figure 6.3).

Sphere Mini-Park

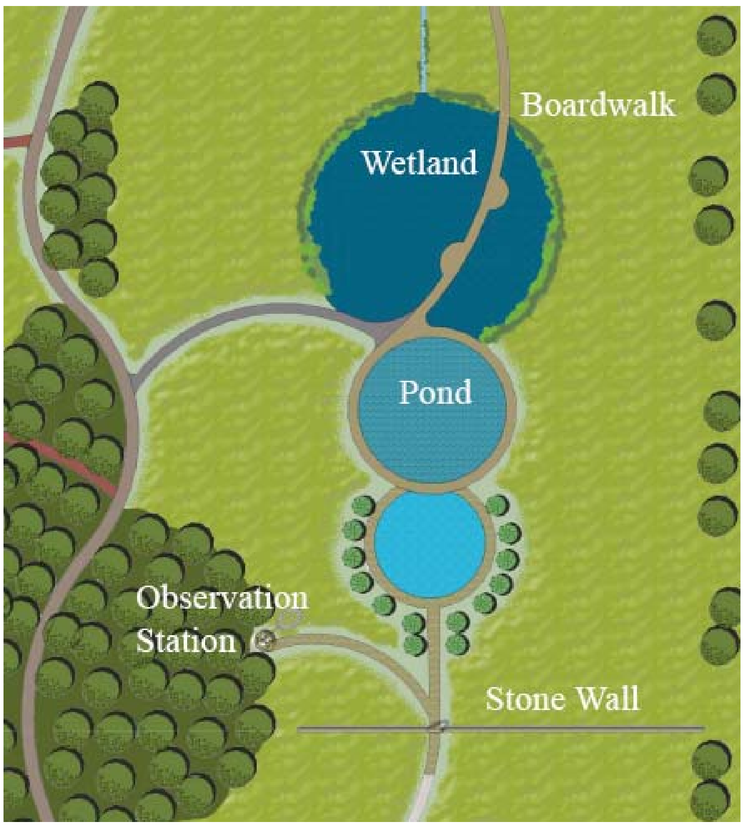
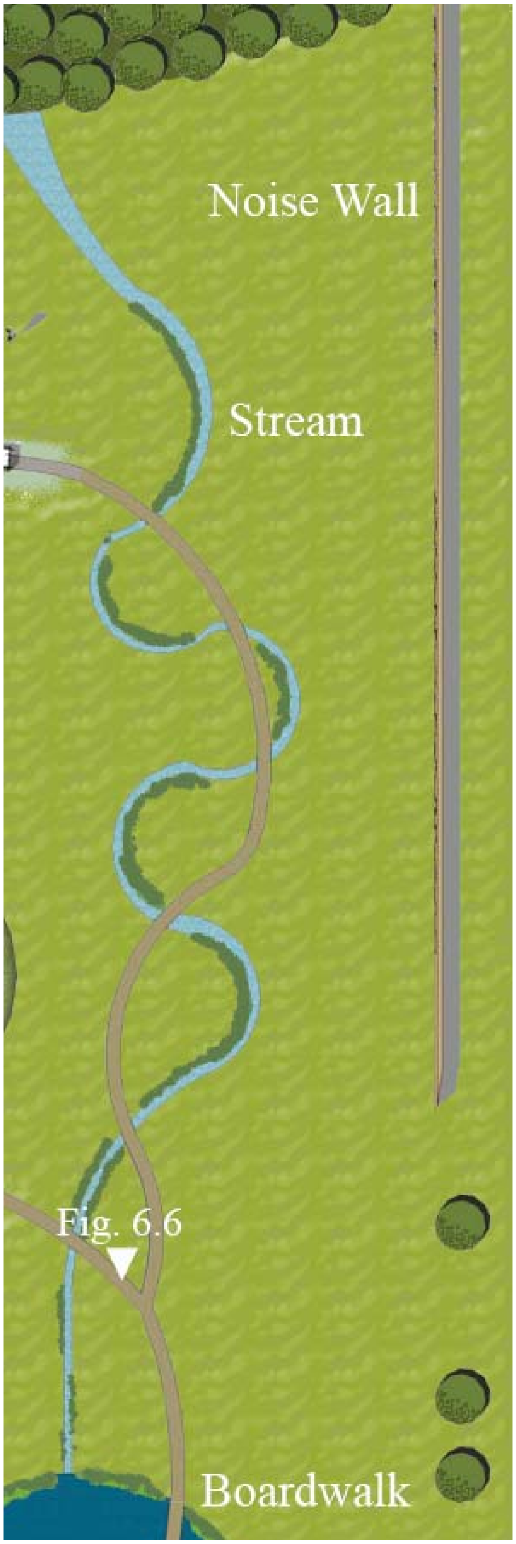


Fig. 6.5. Detail of Sphere Mini-Park

The path transitions from pavers to stone and informs visitors they are approaching the sphere mini-park (figure 6.5). A stone wall with an arched entry acts as a gateway to the next mini-park. Overlooking the space is a globe-shaped observation station that allows visitors a bird's eye view of the site. It consists of a series of three pools that become progressively more natural looking. The first pool is more formal and is encircled by a stone pathway lined with hawthorn trees, which produce spherical fruit. The fruit highlights nature's use of the spherical form. Floating in the shallow pool are opaque balls that glow blue and pays homage to the blue lights that Skiles Test was famous for displaying. The "formal" pool spills into the middle water body, which is more akin to a small pond. Its banks are lined with plantings rather than stone, and while more natural-looking than the first pool, it does not have large amounts of fringe vegetation. The path becomes a boardwalk and likewise encircles the pond. The middle pond empties into the final water body that is reminiscent of a marsh. The banks are irregularly shaped and fringed with water-loving species such as rushes, sedges, water plantain, arrowhead, sweetflag irises and water lilies float in the water (figure 6.6). The boardwalk crosses through the center of the marsh giving the visitors a sense of walking on water.

Fig. 6.6. Sphere and Meander Mini-Parks

<u>Meander Mini-Park</u>



The marsh flows into a stream and marks the entrance to the meander mini-park (figure 6.7). The stream takes on the zigzag form seen in a natural stream and illustrates what the meander pattern looks like. The boardwalk path continues into the meander mini-park and undulates vertically as it leads visitors through the area (figure 6.6). A meandering aluminum ribbon adorns the length of the noise wall located on the eastern edge of nature center.

Fig. 6.7. Detail of Meander Mini-Park

Helix Mini-Park

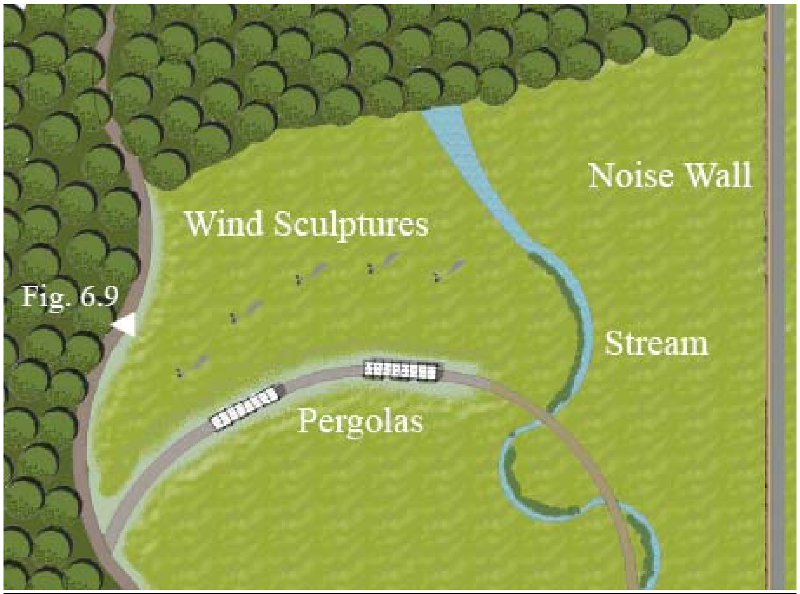


Fig. 6.8. Detail of Helix Mini-Park

Fig. 6.9. Helix and Spiral Mini-Parks

The spiral and helix mini-parks abut the meander mini-park (figure 6.8). Visitors can continue to follow the boardwalk to the helix mini-park. The path transitions to crushed stone and leads visitors back to the main path as it passes through a shady pergola, which provides visitors with a cool refuge (figure 6.9). The pergola exhibits obvious and hidden examples of the helix geometry. Its helical columns support native vines with tendrils exhibiting the helix pattern. A series of metal, helical wind sculptures and helical wind turbines act as a backdrop to the pergola and as a point of interest to draw visitors to this part of the site. The wind turbines also teach visitors about wind generated electricity.

Spiral Mini-Park

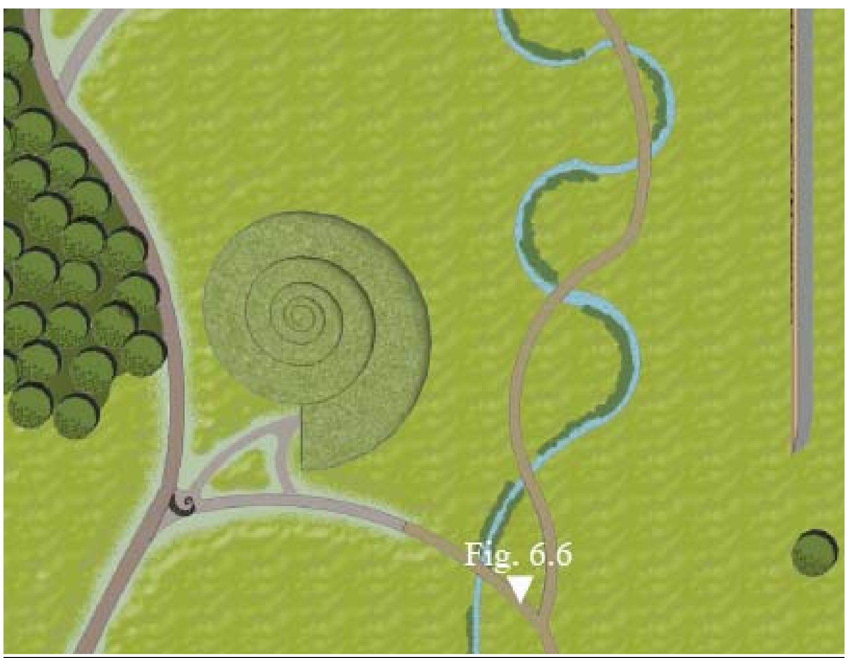


Fig 6.10. Detail of Spiral Mini-Park

Visitors in the meander mini-park also have the option of following a path veering to the west (figure 6.10). The path leads to the spiral mini-park, which takes visitors to a human-made spiral landform and gives them an elevated view of the park (figure 6.9). The path leads to the top of the spiral and is bordered by plants that display spiral patterns such as: ferns, sunflowers, asters, daisies and black-eyed susans. The spiral pattern is visible in the paving pattern located at the entrance of the spiral mini-park, and the pavement is embedded with native mollusk shells.

Branch Mini-Park

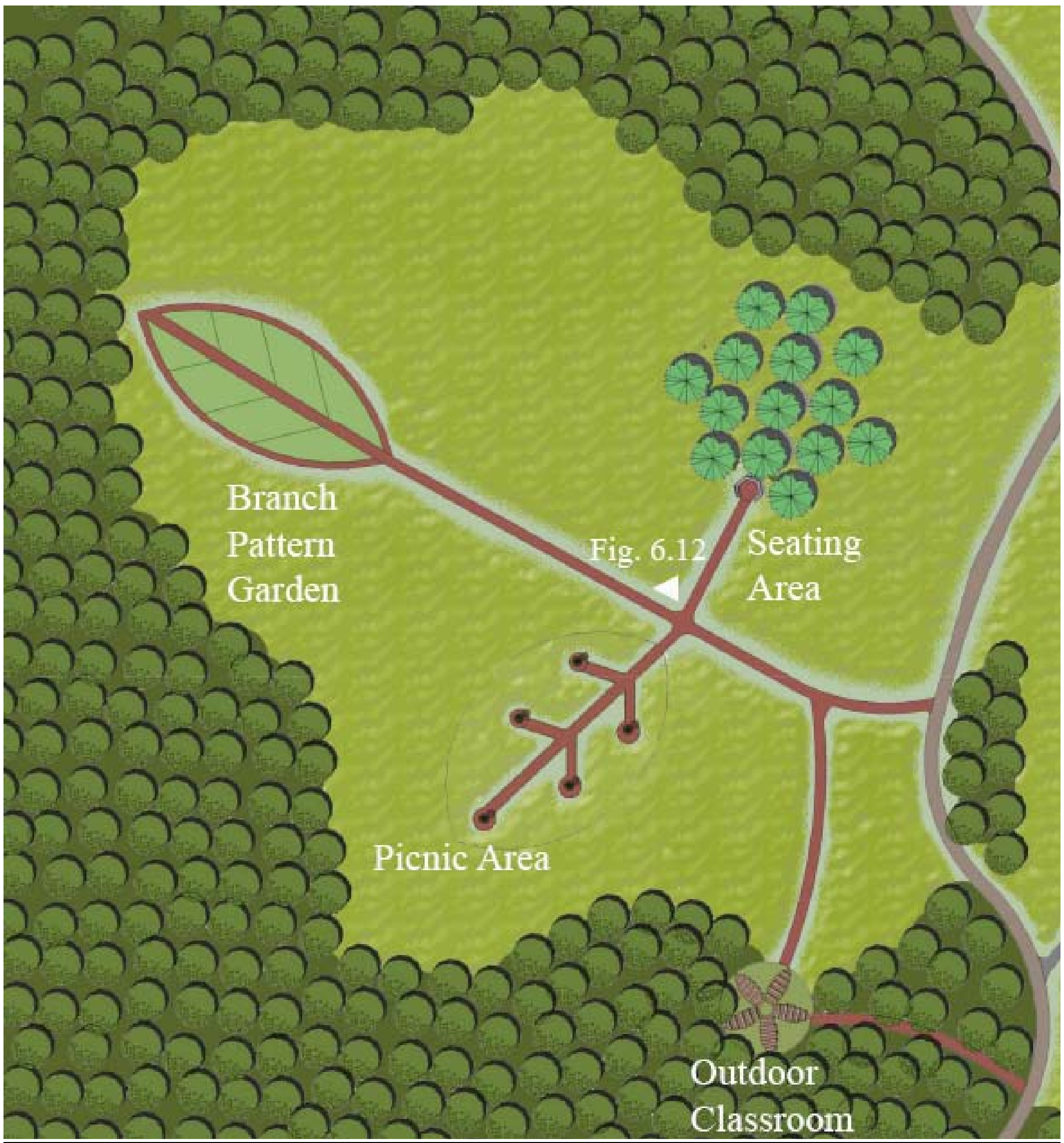


Fig. 6.11. Detail of Branch Mini-Park

Fig. 6.12. Branch Mini-Park

The branch mini-park is a passive space that offers visitors several areas to sit and contemplate the nature that surrounds them (figure 6.11). The leaves of the crossvine, a vine native to Indiana inspire the mini-park's layout. It contains three areas to teach visitors about the branching pattern. Circulation in these areas reflects the branching of the leaves' veins. As one enters the mini-park, one "leaf" is to the right nestled in a stand of existing pine trees, and teaches about the bilateral symmetry branching patterns commonly seen in the needles and branches of evergreen trees. Paving patterns in this area also inform visitors of this pattern. A second "leaf" is located on the opposite side of the path and provides visitors an area to sit, relax and enjoy a picnic while learning about the explosion, double explosion and forked branching patterns (figure 6.12). The picnic tables are covered with canopies that mimic a dandelion (explosion pattern), sweet Alexander (double explosion pattern) and a deciduous tree (forked pattern). The third "leaf" is located at the end of the path and is home to a garden containing plants that display branching patterns such as: dogbane, goatsbeard, queen anne's lace, bee balm, milkweed, red clover and golden alexander. The branch mini-park is also home to the outdoor classroom, where the flowers of the crossvine inspire its design. There is a central teaching area with five "petal" seating areas radiating from the center. The classroom is nestled in the woods overlooking a ravine and provides students the opportunity to learn about nature while immersed in it. It contains design elements that represent all of the center's patterns and offers students the opportunity to synthesize what they have learned during their visit to the nature center.

There are also several exploration trails and meditation spots throughout the nature education center. The center has been designed to include features that allow it to be used in conjunction with the IUPUI Discovering the Science of the Environment curriculum. Such features include wetland ecosystem or slow-moving water, flowing water. The existing site already contains many elements used in this curriculum: wooded and prairie areas.

Fig. 6.13. Skiles Test Nature Education Center Masterplan.

The following table shows how the topics covered in Chapter 2 and provides several examples of how they are represented in the design of the nature education center.

Table 5.1: Representation of Pertinent Topics in the Design

Pertinent Topic	Representation in Design
Center for Earth and Environmental Science – Discovering the Science of the Environment Curriculum Requirements	• Flowing stream • Prairie ecosystem • Wetland ecosystem – pond, marsh, bio-swales • Woodlands
Appleton Prospect-Refuge Theory	
Prospect	Climbing wall, observation deck, spiral landform, paths in ridge areas, sphere mini-park
Refuge	Pergola, meditation spots, picnic area, path running through wooded areas, paths in depressional areas
Kaplan and Kaplan Theory	
Coherence	Organization of nature center into mini-parks each with dedicated to a specific pattern, design elements in mini-parks using the specified patterns,
Complexity	Nature center designed to have obvious and hidden uses of specified pattern
Mystery	Winding paths, spiral landform, paths leading to the crest of hills
Legibility	Organization of paths is such that secondary paths connect with main path through site, wayfinding signs guide visitors through the site.
Iverson's Cues of Human Intent	• Mowed strips along paths • Flowering plants and trees • Use of bold patterns – polygon, sphere, meander, helix, spiral and branch mini-parks • Fences and architectural details – climbing wall, stone fence with arched gateway, observation deck, paved paths, patterned paving patterns, boardwalk, floating spheres in water body, pergola, metal wind sculptures, picnic tables, benches and spiral landform

Pertinent Topic	Representation in Design
Design Trademarks of Jens Jensen	• Children's planting garden, • Stone architectural elements – wall, water feature coping and stone path • Use of native plants • Open spaces – polygon, sphere, meander and branch mini-park • Transitioning path from light to dark – pergola, outdoor classroom area, paths leading from and into wooded areas • "Prairie rivers" – water bodies in sphere mini-park and stream in meander mini-park • Council ring – outdoor classroom • Emphasis on time and change in landscape – plantings in the sphere, spiral and branch mini-park, orientation of outdoor classroom

The process of designing the creative project led to a deeper understanding of the topics covered in Chapter Two. It was pertinent to have a solid grasp on these topics in order to best apply their relevance to the design of the site.

Louv's Nature Deficit Disorder Theory supported the importance of providing children engaging facilities to learn about nature. Exploration of landscape design preference theories helped the author understand the psychology behind why people prefer certain landscapes and what aspects people like about those landscapes. This information contributed to the inclusion of design elements such as the spiral landform, the pergola and paths veering around masses of trees. An understanding of the Visual Stewardship Theory provided the basis for the use of the geometric patterns of nature as a design language that would bring about the positive perception of natural areas. Joan Iverson Nassauer's theorized that recognizable patterns could be employed to put visitors to natural areas at ease. By understanding, the prolific ways that nature designs with these patterns, the author gained inspiration on how to apply those same patterns to site amenities and was furthered convinced that they would be highly recognizable to people of all ages. Investigating the design trademarks of Jens Jensen provided inspiration into features that could work in a setting such as the one available for the creative project. Familiarity with the Discovering the Science of the Environment curricula guided what natural amenities could be included to create an engaging educational experience.

Each topic imparted wisdom that shaped the design of the final product and helped support the hypothesis that nature's geometric patterns create a design language that helps people feel more comfortable in natural areas.

CHAPTER 7 – CONCLUSION

This creative project was guided by three goals: (1) design a nature education facility that teaches about nature and its geometric patterns, (2) facilitate a positive experience of natural areas and (3) foster a healthy ecosystem within project limits. A number of topics were explored in order to create a design that achieved these goals.

The Discovering the Science of the Environment (DSE) curriculum was the basis for the types of site features that provide a rich environmental education experience. The environmental science curricula suggest certain necessary components (i.e. streams, bio-swales, prairies and woodlands) that make a site suitable for hosting the program. The elements aid in teaching students about nature's processes. The design of the nature education center specifically included these elements to make the site ideal for these types of curriculum.

An added dimension to the nature education experience would be the opportunity to learn and teach about nature's inherent geometric patterns. The center was designed in distinctive zones or mini-parks dedicated to one pattern. Each mini-park was designed to include both obvious and less obvious examples of each of the geometric patterns. For example, the sphere mini-park was designed with elements such as orbs floating in the water and paths lined with trees that produce sphere-shaped fruit. This was done deliberately to teach about the pattern and encourage visitors to explore the site in search of other instances of the pattern. Although detailed planting plans were not developed for the creative project, plants were emphasized for their ability to teach these geometries. For example, hawthorn trees were suggested because of their spherical fruit. Ferns, sunflowers and daisies were proposed in the spiral mini-park to draw attention to this pattern. There is a tremendous opportunity to teach nature's geometric patterns on this site through its plants and attention should be paid when selecting the plants for the site.

The most challenging aspect of this creative project was creation of a design that changed how visitors perceive natural areas. In order to do this, it was important to understand what people like about natural areas. Theories and studies regarding landscape preferences were used to guide the design. Based, in part, on landscape preference studies, the site was designed to include a stream, pond, natural paths, masses of forested areas lacking heavy understory paired with open spaces, and intact natural areas without overly intrusive human development. Landscape preference theories resulted in the inclusion of amenities that created a sense of prospect by allowing visitors to see the site from a higher vantage point (the observation deck and spiral landform) and provided refuge in areas such as the outdoor classroom, pergola and meditation spaces. Additional amenities such as wayfinding signs, obvious and hidden representations of geometric patterns, winding paths and dividing the site into mini-parks were other results of an understanding of landscape preference theories. Perhaps most important to the design of this creative project was the idea that orderly frames around "messy" natural areas could be used to create an area that is less intimidating to visitors. These frames were created by using design elements that indicate that people are maintaining the site.

This strategy was the basis for the use of nature's geometric pattern as a way to create natural areas that will be positively perceived by visitors.

A healthy ecosystem was fostered on the site by creating new habitat areas in the sphere and meander mini-parks by planting trees, shrubs and wildflowers that provide micro-habitat, and by recommending the removal of invasive species. One of the project objectives was that the site design be minimally intrusive to existing natural areas while at the same time, creating a space visitors would enjoy visiting. After investigating natural area design theories, it was determined that the visible stewardship aesthetic principle best fit with the goals of this project. Following these principles created a site that is healthy for nature, but also shows signs that humans are maintaining the area, traits important to creating a preferred natural landscape. Trails through the park were designed to follow existing topography and intrude as little as possible on the site. To reduce impacts to natural areas, the center's amenities were confined, where possible, to areas that are degraded or have a history of disturbance.

It is believed that meeting these three goals created a place that will be educational, fun and engaging to visitors and allow them to feel at ease in nature. It will be a space both people and wildlife will want to use. The design that resulted from this creative project will be made available to the Indy Parks and Recreation and Friends of Skiles Test Nature Park in the hopes that it will be brought to fruition.

The location chosen for the creative project was well suited to the author's vision. The surrounding neighborhood, nearby elementary school and Fall Creek Greenway are anticipated to draw a wide range of visitors to the site. The topography, history and existing natural areas were very informative and provided much inspiration for the design. Ravines, steep slopes and flat areas offered a site with both visual appeal and sufficient land area to accommodate the stated design goals and objectives. The site's history informed the placement of the Welcome Center on the site of the former Test home and the main path along the former driveway. Existing natural areas are very unkempt in appearance and represent a visual quality that many find unappealing. The design employed Joan Iverson Nassauer's principles to transform natural areas into spaces visitors would find visually appealing. The site's existing amenities already align closely with DSE curricula requirements making it an excellent host for the program. The design further solidified this fact. The surrounding community's desire to see the site developed into a nature education center with trails and outdoor education areas increases the probability that the design or pieces of the design may someday be constructed.

The project was limited by several factors. Site topography warranted that some earthwork would be required to construct the nature education center as designed. Although the author originally wanted to avoid such activities, the impact was lessened by placing such amenities in previously disturbed areas. A lack of in-depth surveys regarding topics such as site archeology, wetlands, soils, etc. prevented a full inventory of the site. Such surveys may have resulted in the placement of amenities in alternative locations. The biggest limitation was designing without a working budget. The ability to create a design with a reasonable likelihood of construction is hampered by a lack of information about the amount of money available for building the project.

This creative project can also inspire other studies. An inventory of existing major landscape architecture projects containing these patterns could be conducted. The development of curriculum focused on teaching about nature's geometric patterns is one such area that could also be further explored. If the project were to be constructed, post-occupancy studies could provide insight into the success of the project at meeting stated goals. The post-occupancy study could be used to determine if the nature education center taught visitors about nature's geometric patterns by testing their recognition of such patterns before and after visiting the site. Visitors could also be surveyed to determine if the design led to a change in the way they perceive nature.

APPENDIX A: DEFINITION OF TERMS

Coherence: Based on theories by environmental psychologists, Rachel and Stephen Kaplan, it is one of four features that contribute to high preference for a landscape. It results when the elements of a landscape can be easily organized by a viewer. Patterns in a landscape are an example of a feature that leads to coherence.

Complexity: Based on theories by environmental psychologists, Rachel and Stephen Kaplan, it is one of four features that contribute to high preference for a landscape. It creates a space with enough features to be interesting to a visitor, but not enough to overwhelm.

Cues of human intent: Design interventions that signal a visitor that the space is being cared for by someone. Bold patterns, mowed strips, birdfeeders, planted trees and flowers, fences and architectural detail are examples of these cues.

Ecological aesthetic: An aesthetic theory pertaining to natural area design that emphasizes the ecological health of a site. The theory asserts that what is ecologically sound will also look good to people when they have been educated about ecological functions.

Fibonacci sequence: A series of numbers that is closely related to the Golden Section. It begins with 0 and 1. Successive numbers are determined by adding the two preceding numbers (0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377…). These numbers are often observed in the number and arrangement of plant's leaves, petals, florets and seed.

Legibility: Based on theories by environmental psychologists, Rachel and Stephen Kaplan, it is one of four features that contribute to high preference for a landscape. It creates a space that can be explored without fear of getting lost. The presence of open space would be an example of legibility in a landscape.

Learnscapes: The Australian Government's Department of the Environment and Heritage defines them as: "Places where a learning program has been designed to permit users to interact with an environment. They may be natural or built, interior or exterior and may be located in schools, near schools or beyond schools. They may relate to any one or many key learning areas and must be safe and accessible." They are also known as outdoor classrooms.

Mystery: Based on theories by environmental psychologists, Rachel and Stephen Kaplan, it is one of four features that contribute to high preference for a landscape. It implies that the landscape contains more to be discovered and draws visitors in to discover it. A winding path would be an example of a feature exhibiting mystery.

Natural area: An area that is sufficient to provide habitat that is preferred by flora and fauna.

Nature's geometric patterns: the project will focus on six geometric patterns found repeatedly in nature: spheres, polygons, spirals, meanders, branches and explosions. These six geometries are the basis for all of nature's formations.

Prospect-Refuge Theory: A theory developed by Jay Appleton asserts that preferences for landscape result when the biological needs of the visitor are met by the site. Visitors prefer places that provide the ability to see for long distances and gain much information about the landscape without being seen by others. In other words, they can see without being seen. The theory believes this is traced back to early humans and their need for an environment that was optimal for hunting for food.

Scenic Aesthetic: An aesthetic theory pertaining to natural area design that emphasizes a natural-looking landscape that matches the general public's perception of how nature should look. Often such landscapes are not very suitable to wildlife. The theory makes the assumption that what looks good is also beneficial to wildlife.

Visible Stewardship Aesthetic: An aesthetic theory pertaining to natural area design that is essentially a hybrid of the ecological and scenic aesthetics. The theory focuses on ensuring that the landscape appears to be maintained and cared for by humans.

APPENDIX B: SITE PHOTOGRAPHS


North Entrance to Park


Northern Boundary – 65th Street


Residential Area West of Park – Johnson Road


South Parking Area – Fall Creek Road

Paved Trail Leading from Parking Area

Paved Trail Leading into Park

Former Site of Test Mansion

Site of Proposed Nature Center

Site of Proposed Parking Area

Former Drive-way Leading to Mansion

Wooded Area in SW Portion of the Site


Wooded Area and Ravine on West Side of the Site

Sphere and Meander Mini-Park

Helix and Spiral Mini-Park

Successional Area in the NW Part of the Site

Location of Branch Mini-Park

Site of Proposed Outdoor Classroom

Site of Proposed Polygon Mini-Park

APPENDIX C: LANDSCAPE PREFERENCE STUDIES

"Public attitudes towards naturalistic versus designed landscapes in the city of Sheffield (UK)" by H. Özgüner and A.D. Kendle

This study examined public perceptions of urban naturalistic landscapes and formal urban landscapes. Of note to this creative project, the study sought to answer, "Whether or not people consciously or unconsciously have a preference between landscape styles and if so what qualities the favoured landscapes have (Özgüner and Kendle 143)?" The researchers chose two sites in the same area and of similar sizes which were representative of naturalistic and formal urban landscape styles. Sheffield Botanical Garden represented the formal site and Endcliffe Park, a nearby public park, typified the naturalistic site. A questionnaire was developed to gauge public preferences and perceptions for landscapes. A simple random sample was used to find survey participants. Visitors to the sites were randomly selected and a face-to-face interview was conducted (Özgüner and Kendle 143-144). Most felt that both site were tended. However, 20% found Endcliffe Park (naturalistic site) was 'derelict' or 'disturbed'. Most found Sheffield Botanical Garden to be formal and Endcliffe Park to be natural looking. Interestingly, the botanical garden was viewed as natural looking by 26% of the participants (Özgüner and Kendle 146). The botanical garden was viewed as safer, more peaceful, more calming and a better place to relieve stress. Endcliffe Park was seen as a better place to socialize, experience nature and more beneficial to wildlife (Özgüner and Kendle 147). The most popular features of Sheffield Botanical Garden were flowers and flower beds, specimen trees, the greenhouse and neat lawns. Endcliffe's most popular features were water (streams and ponds), trees, woodlands and natural paths. In general, respondents showed a greater preference for natural looking landscapes. However, it seems that their idea of nature and natural differs from that of a more trained individual. Many saw the botanical garden as natural despite its more formal design character (Özgüner and Kendle 153).

"Preference and naturalness: An ecological approach" by A Terrence Purcell and Richard J. Lamb

In this study, Purcell and Lamb investigated viewer preferences for a collection of scenes all composed entirely of vegetation. They operated under the given that people prefer natural scenes. The purpose of this study was to determine the level of naturalness people prefer. Each scene was chosen for its depiction of four variables: type of vegetation formation, structural integrity, density of foliage and extent of view. Prior research has shown that these variables affect ones experience with a landscape and impact landscape preference. Each ecological factor (vegetation type, structural integrity and density of foliage) was represented as two distinct classes. For example, structural integrity was represented as natural and altered, density of foliage was sparse and dense and vegetation type was scrub and low forest. Each combination of these classes was shown at close and wide frames of view. The different frames of view presented differing ways of interacting with the scene (Purcell and Lamb 58). Test subjects (49 in all) were randomly chosen from the University of Sydney, Sydney, NSW staff and students and were shown color slides representing the aforementioned scenes. Subjects were then asked to rate preference for the scene using a 100-point scale (0 indicating no preference and 100 representing most preferred) (Purcell and Lamb 59-61)). The study confirmed that the presence of vegetation does impact landscape preference. Forest was more preferred than scrub. Structural integrity of the vegetation (often used as an ecological measure of naturalness) impacted preferences. Change induced by humankind had a marked effect on preference. Subjects showed greater affinity for intact scenes versus highly altered ones (Purcell and Lamb 64). Several of the study's findings were consistent with Kaplan and Kaplan's model of environmental preference. Low forest at both view extents was preferred. The absence of understory and tree spacing make such forests legible and coherent. Close shrub, which is low in legibility and mystery, is not preferred. Sparse vegetation with close views (high in legibility and coherence) and dense vegetation with wide views (high in mystery and complexity) were highly preferred. The study concluded that preference is not simply a result of the presence of vegetation or lack of glaring human impact. It showed that Kaplan and Kaplan's model of environmental preference seemed to explain subject preferences for scenes (Purcell and Lamb 65).

APPENDIX D
GEOMETRIC PATTERN ANALYSIS AND APPLICATION TO PROGRAM

Sphere

In nature: raindrop, fruit (cherry, crabapple, grapes), eggs, arches (half spheres), bubbles, algae (common shape of organisms living in water), domes.

Possible representations in design: paving pattern, concrete stamping, plant cherry, crabapple trees, pond → algae, waterfowl eggs, bubbles, spheres floating in water, archways/domes, play equipment, structures (shelterhouse canopy), meditation areas, council ring, design accents containing sphere pattern

Site amenities that make suitable for pattern mini-park: area that can be made into pond, suitable for seedling survival, suitable for paths, suitable for structures.

Polygon

In nature: bubbles packed together, honeycombs, snowflakes, ice crystals, internal structure of many marine organisms, vascular systems of flora and fauna, turtle shells

Possible representations in design: paving patterns, concrete stamping, turtles in pond, vertical representations, play equipment, structures (canopy of shelterhouse), meditation areas, design accents containing polygon pattern

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures.

Spiral

In nature: mollusk shells, pond snails, chambered nautilus, rams horns, sunflower heads, composite flower heads (daisy, black-eyed susans, fleabanes), arrangement of leaves around a stem, fern heads.

Possible representations in design: paving pattern, concrete stamping, snails in pond, plantings using flora exhibiting spirals, ramp systems, play equipment, design accents with spiral pattern

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, suitable for planting flora that exhibit spirals, change in topography that could accommodate a ramp

Helix

In nature: DNA, tendrils of vines (grapes, peas,etc), maple and tree-of-heaven seeds, vascular tubes of tree to reinforce cell walls, pine cones

Possible representations in design: planting with flora exhibiting helix pattern, canopy of shelterhouse, meditation areas, vines growing on shelterhouse, meditation areas, helix shaped sculpture that moves in wind, vertical elements with pattern, design accents containing helix pattern (vine tendrils, pine cones, maple samaras)

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, suitable for planting flora that would exhibit helix pattern

Meander

In nature: natural waterbodies, snake paths, Moray eel swimming patterns,

Possible representations in design: streams leading to pond, paving patterns, concrete stamping, paths/boardwalk, active water featurej, play equipment, vertical elements with meander, design accents containing meanders

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, soil that could sustain waterway, adjacent to pond

Branch

In nature: Trees, florets of clover, roots of plants, blood vessels, wild parsnip flowers, , buttonbush flowers, queen Anne’s lace flower, dandelions, goatsbeard, and dogbane fluff, cocklebur seeds, leaf veination, stream systems (first order, second order, etc), evergreen branches and needles, milkweed pod seeds, moose antlers, bird feathers.

Possible representations in design: planting with flora exhibiting pattern, vertical elements, design accents containing branch, paving/concrete stamping patterns, vertical elements with pattern, shelterhouse or meditation area.

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, in or adjacent to wooded area, evergreens present or can be planted in area, flora exhibiting branching pattern present or can be planted in area

Fibonacci

In nature: numbers of petals, spiral pattern of sunflower seed head, arrangement of leaves around a stem, pinecone and pineapple spiral packing pattern

Possible representations in design: garden with flora exhibiting Fibonacci numbers, paving pattern/concrete stamping, design accents showcasing occurrences of Fibonacci numbers (pine cone, sunflower seed head, arrangement of leaves around a stem, etc)

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, suitable for planting flora that would exhibit Fibonacci numbers.

Golden Ratio:

In nature: chambered nautilus spiral, spiral pattern of sunflower seed head, arrangement of leaves around a stem

Possible representations in design: Use golden ratio in design elements, paving pattern/concrete stamping, design accents showcasing occurrences of golden ratio numbers (sunflower seed head, arrangement of leaves around a stem)

Site amenities that make suitable for pattern mini-park: suitable for paths, suitable for structures, suitable for planting flora that would exhibit Golden ratios.

Appendix E – DSE Sample Lesson Description

The Discovering the Science of the Environment's website provides several descriptions of lessons offered by the program. The following is an explanation of what individuals participating in the woodland soils lesson study.

Introductory Activity: Soil Color Chart Construction

Field Activity: Tools Explanation / Soil Mapping, Outdoor Field Study

Description: Utilizing both technology interface and observation skills, students collect and analyze data to draw conclusions about the quality and type of woodland soil at their site. Soil investigations include analysis of soil texture, moisture, temperature, infiltration rates, color, pH and identification of decomposers. Students use Vernier LabQuest scientific handhelds, soil temperature, pH and moisture sensors, soil core samples, and soil texture, plant tolerance and color charts.

Objectives: By the end of the program, the students will be able to:

Define the terms percolation/infiltration, decomposer, humus and erosion

Name the basic components of soil composition

Describe processes that lead to soil formation and degradation

Describe the composition, texture, moisture level and color of woodland soil

Recognize and write basic soil color name and numbers

Construct and interpret a soil color chart

Explain the connection between soil and decomposers

Use scientific investigation tools, observation skills, and flow charts to collect soil quality data

Interpret information and identify certain characteristics that all woodland soils share

Length of Program: Two required visits per participating class. First visit will be introductory, occur either inside or outside, with or without trailer, for a typical class period. Second visit will follow program description, occur outside, with trailer and equipment for 1.5-2 hours. For ease of programming, classroom visit should occur the day before the trailer visit. If school schedule allows, the program can be one day, 3 hours.

Program Availability: September 2, 2008 – November 28, 2008 and March 30, 2009 – June 12, 2009.

Site Requirements: Access to forest or natural wooded area

Cost: None.

All equipment, teaching materials, and technology are provide free of charge.

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